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UNIVERSITY OF ALBERTA

The syllable structure of French as perceived by first and second-language speakers

by

Martin Beaudoin

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of
Doctor of Philosophy

in

Romance Linguistics

Department of Romance Languages

Edmonton, Alberta
Spring 1996

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FACULTY OF GRADUATE STUDIES AND RESEARCH

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ABSTRACT

The main goals of the research presented here are to provide a better understanding of the preferred syllable structure of French, and to verify whether or not second-language (L2) learners have patterns of syllable preferences similar to those of L1 speakers.

The first experiment yields an analysis of the role played by the presentation mode of the possible ways to parse CVCV stimuli, using a forced-choice syllabification task methodology administered by computer. Results indicate that presenting stimuli visually or aurally does not affect significantly the pattern of syllabification. However, because the visual presentation is more convenient, it was used in the next two experiments. Results also indicate that the number of letters used to spell intervocalic consonants is a highly influential factor. French speakers generally divide CVCV words before the intervocalic consonant with singlets, but seem to perceive that consonant as ambisyllabic more often with doublets.

The second experiment is a verification of the preferred syllabification of CVCV words for French as L1 and L2. L1 speakers generally divided these words as two CV syllables. L2 learners had significantly less CV syllables and more CVC syllables. However, L2 learners were not influenced by phonemic components of the French syllables, as they were when dividing words in their mother tongue. L2 speakers of French syllabified French stimuli as if their representation of the French syllable were a mixed structure of their L1 and L2. This

mixed L1-L2 syllabic structure is in keeping with observed general patterns of interference in L2 learning situations.

The third experiment provides an analysis of syllable structures involving consonant clusters in intervocalic position. Generally, the findings support the predictions made on theoretical grounds. However, parsing of the stimuli was somewhat influenced by their morphological makeup.

The conclusion drawn from these results is that the L1 syllabification of French is regular and consistent with previous theoretical and pedagogical work, if the number of letters and the number of morphemes in the stimuli are controlled. Furthermore, results in L2 syllabification show that syllable structure can be learned, at least partially. Pedagogical implications are discussed.

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Freilich dreht das Rad sich immer weiter
Dass, was oben ist, nicht oben bleibt.
Aber für das Wasser unten heisst das leider
Nur: dass es das Rad halt ewig treibt.

Bertol Brecht

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List of Abreviations

In general, the IPA is used throughout the text. In addition to that, certain statistical abreviation, and abreviations specific to this study are to be found:

L1	first-language, mother tongue
L2	second-language
N.S.	not significant (in a statistical analysis)
O	any obstruant
C	any single consonant
Cn	any consonant cluster
V	any vowel
V1	the vowel preceding the intervocalic consonant(s) in a bisyllabic word
V2	the vowel following the intervocalic consonant(s) in a bisyllabic word
CV	a syllable made of a single consonant and a vowel (open syllable)
CVC	a syllable made of a single consonant, a vowel, and followed by another single consonant (closed syllable)
AMB	a consonant that is found both as the coda to one syllable and as the onset of the next syllable. By extension, a pair of syllables where such a consonant is found (called ambisyllabic judgments).

Chapter 1

General introduction

The general goal of this thesis is to shed some light on how and to what extent English-speakers learning French acquire a prosodic structure, namely the syllable. It is generally known that syllable structure greatly influences the pronunciation of a speaker, especially an L2 speaker (Trammell, 1993). It is tempting to assume that all is known about the French syllable, because Delattre's work produced many articles on the subject in the first half of the century. Although what Delattre proposed for teaching purposes about the syllable structure of French generally makes sense and is widely applied in L1 and L2 French classrooms around the world, nobody has verified this work experimentally. This thesis is an attempt to test, not challenge, some of the syllabification "rules" proposed by Delattre (1940; 1944a; 1944b) and to study the possibility of acquisition of the French syllable structure by L2 learners. Of course, one cannot undertake the second aspect of the thesis without first verifying Delattre's rules.

In the following pages, the theoretical background underlying the research presented in the next chapters is summarized. The first section is devoted to defining and justifying the syllable, and to describing its components. The second section is an analysis of the research done on the psychological reality of various units of representation commonly referred to in modern linguistics, the syllable being one of the main units. It is only in the third section that the research becomes specific to syllable structures; in this section, by studying the acoustic cues to syllable parsing, I want to show that there is at present no known way to describe the syllable phonetically. The fourth section describes the lack of uniformity in the structure and the importance of the syllable

among various languages. This lack of uniformity is expected since there is no phonetic definition of the syllable. The fifth section describes the experimental protocols used to study the syllable in the past. This description will clarify the sixth section, which focuses on the syllable structures of French and English. Despite the fact that French is the language studied here, English syllable structure is also studied because it is believed to influence English speaking second-language (L2) learners of French. The seventh section explains how this process of influence is taking place from the stand point of contrastive analysis theories. A brief description of the experiments done for the present thesis is also given in light of the literature reviewed.

The syllable has always been the focus of a great deal of discussion among linguists, be it for its definition or even for its very existence. Actually, there is still little agreement on its phonetic definition (Bell & Hooper, 1978; Maddieson, 1985). In fact, some of the recent articles do not even attempt to define it (Fowler, 1990; Nearey, 1990; Treiman, 1988, among others). The main reasons for such difficulty in the phonetic definition of the syllable are that the acoustic factors defining syllable boundaries have not yet been isolated, and that its definition may vary from one language to another. Nevertheless, most people appear to be able to perceive its presence without being able to explain how they do it. Whether the syllable is a linguistic or a cultural phenomenon is still unclear. However, there are indications supporting the conclusion that the syllable is phonetic rather than phonological. Indeed, deaf talkers are not affected by shortening effects that are normal to the language they speak (Tye-Murray & Woodworth, 1989). Furthermore, evidence against the existence of syllable structures was found in American Sign Language spelling (Wilbur & Allen, 1991).

The existence of the syllable has been justified by the fact that it appears to be perceivable by speakers of all languages to various degrees (Bell & Hooper, 1978; Brière, Campbell, & Soemarmo, 1968);

because of its importance in coarticulation (Lisker, 1978; Benguerel & Ukrenainetz McFadden, 1989; Recasens, 1991); and because of error patterns in children's speech (Ingram, 1978). The syllable is also believed to be important for the acquisition of literacy (Gibson & Levin 1985; Liberman, Shankweiler, Fisher, & Carter, 1974; Beaudoin, 1989; Wimmer, Landerl, Linortner, & Hummer, 1991).

From a theoretical aspect, Selkirk (1982) contends that:

> First of all, it can be argued that the most general and explanatory statement of phonotactic constraints in a language can be made only by reference to the syllable structure of an utterance. Second, it can be argued that only via the syllable can one give the characterization of the domain of application of a wide range of rules of segmental phonology. And third, it can be argued that an adequate treatment of suprasegmental phenomena such as stress and tone requires that segments be grouped into units which are the size of the syllable. (p. 337)

Although some research on the syllable has been published without even attempting to define it (Touati, 1987; Treiman, 1988; Nearey, 1990; Cutler, Mehler, Norris, & Seguí, 1986; Wioland, 1985), I will use a definition taken from O'Connor & Trim (1953): the syllable is "a minimal pattern of phoneme combination with a vowel unit as nucleus, preceded and followed by a consonant unit or permitted consonant combination" (p. 120). The consonant units or clusters preceding or following the nucleus are optional. The nucleus can be a vowel or a consonant, although few consonants are found as the nucleus and in only a limited number of languages (Treiman, 1986; Rosetti, 1961; Bagemihl, 1991). The number of consonants surrounding the nucleus varies and some limits of combinations and of distribution also affect syllable structure. The consonantal group

preceding the nucleus is called the onset and the consonantal group following the nucleus is called the coda.

A number of studies attribute to the syllable a hierarchical organization. In some languages, the onset is strongly linked to the nucleus to create the *head* (or body) (Derwing, Yoon, & Cho, 1993 for Korean), whereas other languages show a strong link between the nucleus and the coda, called the *rime* (Treiman, 1983; 1985; 1988; Derwing, 1992; Treiman & Danis, 1998b; Wise, Olson, & Treiman, 1990). A language where the onset is strongly linked to the nucleus is called *left-branching* whereas a language where the coda is strongly linked to the nucleus is called *right-branching*.

As will be seen later in this chapter, a considerable amount of theoretical work has been done on the French syllable, whereas experimental verification has mostly been neglected. For English, both aspects have been well studied. The theoretical side will not be fully developed for the moment because this thesis is essentially experimental. See Selkirk (1982), Clements & Keyser (1983), and Vennemann (1988) for theoretical models of syllable structure, Kahn (1976) for an in-depth analysis of ambisyllabicity, and Dell (1995) for a theoretical analysis of the consonant clusters in the syllable structure of modern French.

The existence of the syllable is supported by a large body of research across languages, even if no precise and universal way to describe syllable boundaries acoustically have been found. This research will now be reviewed in the next three sections; the psychological reality of various units of representation, the existence of acoustic cues to syllable parsing, and the relative importance of the syllables across languages.

The units of representation

The speech sounds produced by human speakers are assumed to be represented in some way in the mind. Following Ohala (1990), I

will assume that the study of the articulation of speech and the study of the representation of speech are embedded into one research discipline. Although on-line speech is continuous, it is studied as a sequence of discrete units. Furthermore, since it is very unlikely that speech is represented in the brain in terms of the acoustic values of the streams of sounds (Fowler, 1990), and since the units of representation result from categorization, I will assume that they are conventional and arbitrary. If these units are arbitrary, there is no reason to assume that the units and their size are constant (Hammarberg, 1982), or that they are comparable cross-linguistically (Norris & Cutler, 1988). The problem to be addressed in this section of the introduction is the size of the units for the representation of speech.

The most commonly used size of the unit of representation of speech is the phoneme. This is supported experimentally by research on adult English speakers (Nearey, 1990; Healy & Cutting, 1976; Norris & Cutler, 1988). For example, Norris & Cutler (1988) had subjects perform a phoneme and syllable monitoring task on words and non-words. This is a type of experiment in which subjects are presented with a stimulus as either a sentence, a phrase, a word or a nonsense word, and they must indicate whether a given phoneme or a given syllable was present in this stimulus. The results of Norris & Cutler clearly show that phonemes are accessed faster than syllables, indicating that the phoneme is a representational structure. No similar research could be found for languages other than English, and only adult subjects appear to have the pattern of results supporting phonemic representation. Fowler (1990) argued that very few language phenomena are limited to the phoneme, i.e., coarticulation, stress, intonation, and so on. This is true, but it can also be argued that many phenomena take place on a smaller scale than the phoneme (i.e., features) and on a larger scale than the syllable (i.e., sentence prosody, morphophonological processes, etc.). Nevertheless, the phoneme has been a useful unit for linguistic analysis. Furthermore, some speech errors such as spoonerisms cannot be explained without it.

The unit of representation can also be combinations of phonemes or parts of phonemes. Among these possible combinations, the most frequently evoked are the diphone, the demi-syllable, and the transeme. The diphone is the phonetic substance between the middle of a phoneme and the middle of the following phoneme. The demi-syllable is the phonetic substance between the first third of a phoneme and the first third of the following hypothesized segment. The transeme is the phonetic substance between the second third of a phoneme and the first third of the following phoneme. The use of the diphone, the demi-syllable, and the transeme is justified in theory by research on coarticulation (Hammarberg, 1982). These units of representation are also useful in automatic speech recognition (Lee, Hon, & Reddy, 1990). However, they have found little experimental support in speech perception by humans, probably because almost no research has been done on them. Furthermore, the lack of usefulness of a unit for automatic speech recognition does not preclude the possibility that it is a valid unit for human representation.

The problem here is that speech units are artificially defined and assigned to continuous speech. In actual on-line speech, phonemes overlap each other acoustically. This mutual influence is called coarticulation. French /R/ in onset position is a good example of coarticulation because its articulation is influenced by the following vowel: in a word like /Ru/ "wheel", the lips are rounded before the beginning of the actual pronunciation of the /R/, whereas in a word like /Ri/ "rice", the lips are not rounded (Giannini, 1987). More generally, the period of transition between phonemes is also said to be an essential cue for the identification of the following phoneme (Border & Harris, 1980).

The scope of coarticulation is limited by syllable boundaries. This limit has yet to be identified acoustically, although speakers of natural languages can identify it relatively easily. This makes the syllable a solid candidate in the "search for THE single unit of representation", despite the difficulty in demonstrating its reality acoustically. The

syllable could also have no simple acoustic correlate and still have psychological reality.

The concept of syllable is supported by research in different languages and for different age groups. Bertoncini & Melher (1981) and Jusczyk, Kennedy, & Jusczyk (1995) validated it for infants. Liberman et al. (1974) and Walley, Smith, & Jusczyk (1986) verified it for English speaking children developing literacy at different stages. Wijnen (1988) verified it for young children speaking Dutch. Lehiste (1978) verified it for Estonian. Mehler, Dommergues, Frauenfelder, & Seguí (1981) and Cutler, Mehler, Norris, & Seguí (1986; 1992) verified it for French.

Some factors are known to influence the results of such experiments and their interpretation. It appears that the development of literacy for languages with alphabetical orthographies facilitates phonemic monitoring rather than syllable monitoring (Liberman et al., 1974; Walley et al., 1986; Wijnen, 1988; Gibson & Levin, 1985; Vellutino & Scanlon, 1987; Wimmer et al., 1991; Kirtley, Bryant, MacLean, & Bradley, 1989). Children who cannot read find it very difficult to divide words into phonemes (Wijnen,1988; Gibson & Levin 1985; Morais, Cary, Alegria, & Bertelson, 1979; Wimmer et al., 1991). In addition, Treiman & Breaux (1982) showed that English speaking preliterate children perceive overall similarities between words whereas English speaking university students perceive phonemic similarities. This led to the conclusions that phonemic representation may only be developed after the acquisition of literacy. Literacy teaching techniques apply these conclusions in many instances by teaching words globally at first and then go onto smaller units such as the phoneme. The application of these conclusions to literacy teaching could be verified by having a group of analphabetic adults perform a phonemic monitoring task with a group of literate adults of comparable age and socio-economic status as a control group. It should be easy to find analphabetic adults since they constitute about

5% to 15% of the Canadian adult population (The Edmonton Journal, Jan. 25, 1993, A1-A2).

Since speakers who have not been trained to read alphabetically find phonemic segmentation (also called phonological awareness) very difficult (Morais et al., 1979), it is difficult to imagine speakers of a language with an ideographic system such as Mandarin being capable of phonemic segmentation. Speakers of languages with ideographic systems have no reason to develop a phonemic representation. Seidenberg (1985) states that Chinese subjects access phonemic representations when processing low-frequency words. The Chinese subjects involved in his experiment were probably bilinguals; although minimal description of the subjects is given, these subjects were studying at McGill University, so we can expect them to have developed some phonological representations for English. Therefore, the phonemic representation found during the experiment may very well be at least in part the result of exposure to an alphabetically written language. The same criticism applies to the work of Perfetti & Zhang (1991), Perfetti & Zhang (1995) and Tan, Hoosain, & Peng (1995), who all claim that Chinese subjects access phonemic units. Huang & Hanley (1994) studied access to phonemic and syllable representation units with analphabetic Chinese children and they found no supporting evidence for phonological awareness. Care should be taken in designing such experiments because some of the Chinese now use a phonemic alphabet (Pinyin) in their early school years to help them learn the ideographic system. In the past, other systems were used, among which were the Wade-Giles (Crystal, 1992).

In reality, one does not even need to study languages with different orthographic systems to find divergent results on the type of representational units of language. For example, Cutler, Mehler, Norris, & Seguí (1986; 1987) found that French speakers have little if any access to phonemic representations but rely mostly on syllable information, whereas English speakers mostly access phonemic information in processing language with very little need for syllable

information. The source of these differences may be linguistic but it could also be educational or cultural.

Furthermore, Cutler et al. (1987) found that the degree of monotony of the phonemic monitoring task also influences the results. Indeed, a monotonous task can lead the subject to stop paying attention to the meaning of the items in a phonemic monitoring task. They may only look for a given phoneme or syllable and treat all of the stimuli as nonsense words. This does not affect the result of all experiments, however, so one cannot generalize the results to natural languages without a certain inherent risk, since languages are usually used to convey meaning. The subjects may process meaningless stimuli differently than meaningful ones. According to Cutler et al. (1987), simply varying the length of the stimuli can break the monotony of a task.

McNeill & Lindig (1973) found that the structure of the lists used in perceptual experiments also influences the results. This work is confirmed by that of Healy & Cutting (1976). Their results indicate that English speaking subjects performing identification tasks are faster at identifying syllables if the list consists of mono or bisyllabic words, and phonemes are identified rapidly within a list of monosyllabic words. However, these subjects are slower to identify syllables in trisyllabic words or sentences, and phonemes are identified slowly in units longer than monosyllabic words. They conclude that the target item is easy to identify as long as the items in the list are not too much longer than the target item. In other words, the easiest context in which an item may be identified is the context in which the stimulus is of equal size to the target or no more than one step longer, considering the phoneme to be the shortest item, followed by the syllable, the word and the sentence.

It becomes evident by this point in the discussion that THE unit of representation of language has not yet been isolated. Both the phoneme and the syllable have found support and opposition. Intermediate units

such as the demi-phone, the demi-syllable and the transeme have not been studied to a sufficient extent to be seriously considered here. The phonemic representation model is convenient, for it corresponds to the unit used by linguists in their description of language. Nevertheless, there is a trend toward the use of syllable representation models because, as discussed above, a very large proportion of human beings may have no access to any phonemic representations as discussed above, either because their writing system is not alphabetical or because they are simply illiterate. It may be the case that phonemic representations exist for a minority of people, and in this respect they are important. However, phonemic representations may very well be an artifact of alphabetical literacy, occurring in only a small population in specific situations.

Despite this lack of conclusive data, the study of both types of units of representation (the phoneme and the syllable) is justified by their importance in speech synthesis and in automatic speech recognition (Nearey, 1990 for phonemic representation; Waibel & Lee, 1990; Mermelstein, 1975 for syllable representation), and also in second language education (Huot, 1978 for phonemic representation in anglophones learning French; Brière et al., 1968 and Delattre, 1944a and 1944b for syllable representation). As Cutler & Otake (1994) concluded, different languages may very well have language-specific processes to input speech.

One question that arises out of the discussion on the units of representation of speech is whether the syllable has a phonetic reality — we know that phonemes do. It is justified phonologically, since it is essential in explaining a large number of phonological processes in almost all languages (Selkirk, 1982; Clements. & Keyser, 1983). This seems to be supported by most of the research that was just presented. The phonetic reality of the syllable would be verified if acoustic cues could be found for syllable structures. However, acoustic cues could potentially vary from one language to another, so that a phonological structure might be phonetically implemented differently in different

languages. The next section of this chapter will be devoted to the study of acoustic cues to syllable parsing.

The acoustic cues to syllable parsing

The syllable was defined above as a string of phonemes including a nucleus and optionally surrounded by consonants. If the syllable is justified phonologically, and if it has any psychological reality, there could be a mapping of the phonological structure onto the acoustic structure of speech. Despite a few attempts to identify the cues that would allow us to automatically parse words into syllables, there is little agreement on the results. There have only been three extensive studies which addressed this question. These are that of Maddieson (1985), who reviewed numerous studies, and that of Boucher (1988), who studied various acoustic factors and found only the effect of duration of the consonant's hold-closure to be a significant predictor for syllable parsing in English. Quené (1992) found through an acoustic analysis and a perception study that consonant duration is a significant predictor of perceived syllables in Dutch. These studies will be reviewed below, but important information should be considered before analyzing these three articles in depth.

One of the factors that should first be considered is the voicing of the following consonant. Voiced consonants in the coda generally lengthen the preceding vowel (Lisker, 1978; Kluender, Diehl, & Wright, 1988; Fintoft, 1961; Crystal & House, 1988; Laeufer, 1992 Wardrip-Fruin, 1982; Port, Al-Ani, & Maeda, 1980, but only for Japanese). Note that the distinction voiced/unvoiced in numerous articles is used to cover the distinction aspirated/unaspirated. Note also that this phenomenon fits under a more general phenomenon called compensatory shortening, which covers the various adaptations of duration by the vowel depending on its environment. Vowel lengthening in the ante-voiced context does not happen in Arabic (Port et al., 1980). If this is related to Maddieson's conclusions (i.e., longer vowels lead to open syllables, as will be discussed later), then voiced consonants in VCV contexts would be syllabified as onsets with the

second vowel more frequently than voiceless consonants. Indeed, we just saw that voiced consonants in the coda lengthen the preceding vowel, and Maddieson claims that longer vowels lead the post-vocalic consonant to be syllabified as the onset of the following syllable. To the best of my knowledge, such differences in syllabification for voiced and voiceless consonants have never been reported.

Apparent vowel lengthening in the ante-voiced position could be the result of a "natural tendency to make a slightly early glottal opening gesture for a postvocalic voiceless consonant in order to insure that no low-frequency voicing cue is generated during the obstruent" (Klatt, 1976: 1214). As Kluender et al. (1988) pointed out, it could also simply be to enhance the distinction between voiced and voiceless stops. The latter hypothesis is consistent with the fact that the degree of voicing varies among languages. This is also suggested by the fact that initial voiceless stops are aspirated in English where there is no preceding vowel to specify the voicing of the initial stop. However, Fowler (1992) replicated the study of Kluender et al. with vowel-like and consonant-like sounds and showed that vowel lengthening in ante-voiced position cannot be due to acoustic factors, which was supported by Munhall, Fowler, Hawkins, & Saltzman (1992).

Nevertheless, the importance of vowel lengthening before a voiced stop is counterbalanced by the fact that the hold-closure of voiced stops is shorter (Lisker, 1978). Overall, the VC portion of a syllable is not significantly different for voiced and voiceless stops. The duration of these syllables can in turn be influenced by the stress pattern of the language, since stress influences the duration of the vowels (Fant, Kruckenberg, & Nord, 1991; Edward & Beckman, 1988; Campbell & Isard, 1991). In Lisker's experiment, the words all had the same stress structure, so that stress cannot have biased the results.

Stress has an important influence on the duration of various aspects of speech in some languages, and this is especially true for

English. Vowel duration is largely determined by the stress it receives in English: stressed vowels are longer (Crystal & House, 1990). Since consonants also tend to be attracted by stressed vowels (Treiman & Danis, 1988), the duration of the syllable is indirectly determined by the stress it receives. Furthermore, various syllable patterns will influence syllable duration to different degrees. Indeed, Fourakis & Monahan (1988) showed that in English the stressed syllables found before anapestic feet were lengthened, but those found before iambic feet were not. Thus the duration of stressed syllables is determined by the anticipation of the number and the stress pattern of forthcoming syllables. This also correlates with the finding that the syllables of a word are strictly sequentially encoded (Meyer, 1990). However, Van Lancker, Kreiman, & Bolinger (1988) showed that the lengthening of syllables is not related only to stress in English. Indeed, even simply having a full vowel in the first syllable and another full vowel in the following syllable will lead the first vowel to be longer than it would be if the second vowel was a reduced vowel.

Coarticulation is a similar process in that it is the internal qualitative influence of the parts of the syllable on each other. The portion of sound between the two phonemes in coarticulation is called transition. Since the movement of the speech anatomy requires time, there are overlapping articulatory characteristics for the various sounds within a syllable (Maeda, 1991; Fowler, 1980). Coarticulation is generally assumed to be limited to the syllable. However, the strength of coarticulation is influenced in English by stress structure: stressed syllables have reduced coarticulation (De Jong, Bechkman, & Edwards, 1993).

Coarticulation, in turn, may be influenced by other factors. Fowler (1981) found that there is a correlation between coarticulation and compensatory shortening. This is not surprising since the shortening of vowel duration is mainly related to the duration of the following consonants (Lisker, 1978; Fintoft, 1961; Crystal & House, 1988, among others), and coarticulation in English is the most noticeable

between a vowel and the consonant following it (Recasens, 1991; Peterson & Lehiste, 1960). Fox (1989) also showed that the transitions between consonants and vowels in English are important cues for the identification of vowels. Similar results were found for Finnish using a different protocol (Suomi, 1987).

As we just saw, the directionality of coarticulation may also be an important factor in syllable structure. In English for example, there is a strong coarticulation between a vowel and the consonant following it, and there is a weak coarticulation between a vowel and the preceding consonant (Recasens, 1991; Peterson & Lehiste, 1960). Furthermore, lip rounding anticipation is not found in English (Gay, 1978) but is found in French (Giannini, 1987). In French, the general tendency of coarticulation seems to be reversed with respect to English coarticulation; in French, coarticulation between a vowel and the preceding consonant is stronger than coarticulation between a vowel and the following consonant (Delattre, 1944a). This may be related to the fact that 80% of syllables in French have no coda whereas only about 40% of the English syllables have no coda (Wioland, 1985). Japanese seems to have the same tendency on the directionality of coarticulation as French (Homma, 1981). Dutch vowels, on the other hand, have an almost equal strength of coarticulation from both the preceding and the following consonants (Schouten & Pols, 1979a and 1979b). Manuel (1988) proposes that languages tend to accept coarticulation if it does not lead to confusion between contrastive phones.

All of these factors should be considered when looking for the acoustic cues for syllable parsing. It is difficult at this point to persist in looking for cues that could be universal because of the number of fundamental differences among the languages discussed above. Nevertheless, language-specific studies may still lead to the isolation of good cues for particular languages. Maddieson (1985) found that vowel duration is a good cue for a number of languages: a longer vowel leads to a CV syllable. Quené (1992) found that the duration of

consonants is a good predictor of the perceived syllable. Also, Boucher (1988) found that the duration of the hold-closure of the consonant in the coda is the best cue for English syllabification. Vowel duration is influenced by the voicing of the consonant in the coda and the duration of the hold-closure of any stop is also influenced by its own voicing. It is difficult to solve the ambiguity among results obtained in these three articles. However, Maddieson's study suffers significant flaws. These will now be discussed.

Maddieson's article is a summary of many studies. Some of the conclusions that he reported contradict those given in the original studies. For example, McKay (1980: 346) was quoted as saying that "In general shorter vowels occurred before the geminate stops than before the single stops". In fact, McKay concludes two sentence later that this trend was not significant: "The length of vowels has been interpreted here as insignificant." (1980: 346). Also, Fintoft (1961) was said to have found certain results that were not explicitly stated in the original article, and these results had to be extracted and computed in an undescribed way by Maddieson. Furthermore, Balasubramanian (1981) found that short vowels were 14 msec longer before voiced consonants than before voiceless ones (Maddieson, 1985: 217), but Maddieson failed to mention that Balasubramanian found that only the first vowels of V.CV and CV.CV words were longer before voiced consonants than before voiceless consonants. In VC.CV and CCV.CV words, the first vowels were actually shorter before voiced consonants than before voiceless consonants (Balasubramanian, 1981: 153).

Davis & Van Summers (1989) presented results for English that confirmed Maddieson's claims, but only for stressed syllables. They showed that English unstressed vowels are not consistently influenced by the voicing of the following consonant. Following Maddieson's model, this would lead us to conclude that unstressed syllables are more prone to be CV syllables. Homma (1981) found that the duration of Japanese vowels is influenced by the presence of a geminate preceding the vowel instead of following it. Maddieson tried to

discredit this study by pointing out that Japanese is a mora-timed language and thus the first consonant of a geminate is considered a syllabic consonant. While this may be correct, it does not explain why there is a significant difference in duration between vowels preceded by a single consonant and vowels preceded by a geminate, if the second consonant of the geminate merely becomes a single consonant. Inuit Uqausingit (an Inuit language of North-Eastern Québec) has three short vowels and three long vowels of the same quality /i/, /ɑ/, and /u/. All of these vowels are found before and after single and geminate consonants (Dorais, 1975). Again, this contradicts Maddieson's model.

Some important points have also been omitted by Maddieson in the discussion of the French data, especially when he says that "These are not languages that have geminates of the sort found in the languages surveyed above." (p. 214). First, all word boundaries are not equivalent in French because of the phenomena called "liaison". It follows that the geminates that appear at word boundaries are actual geminates (Delattre, 1981). The syllabification of "la folle idée" /la.fɔ.li.de/ (the foolish thought) is actually a concatenation of the second and third word to create the third syllable /li/, and not /la.fɔl.i.de/ or /la.fɔl.id.e/ (Delattre, 1981). Furthermore, French voiced fricatives in codas under phrase-final stress lengthen the vowel preceding them to a highly perceivable degree (Walker, 1984). French vowels also have different durations depending on the phonetic context. For example, the nasal vowels and /ɑ/, /o/, and /ø/ are long in close accentuated syllables (Gendron, 1966). The other vowels are short everywhere except in accentuated syllables having a voiced fricative as a coda. It becomes difficult then to think that one single cue will parse syllables consisting of a whole set of consonants and vowels for even a single language.

As indicated at the beginning of this discussion, the acoustic cues to syllable parsing have not yet been isolated. Maddieson's study has been discredited on many points. Boucher's study has some potential but its conclusion is limited to stops, since the hold-closure on which

the study is based only exists in stop consonants. Quené found an interesting and potentially valid acoustic factor to predict syllable parsing loci but tests remain necessary for other languages. The possibility of having different cues for different syllable structures and possibly for different languages should be considered here. The absence of coarticulation between two phonemes may also be a potential cue to syllable parsing. This was suggested by Malmberg (1967), and it would be consistent with the mentalist point of view developed by Fowler (1980; 1990; 1992). According to Fowler, the perception of speech is an organized process and the source of organization is internal to the speaker. Under this analysis, the syllable could be defined as the unit of speech to which the acoustic interaction between phonemes is limited. This definition allows the flexibility required to explain the structural variability of the syllable across languages.

Finally, it should be noted that a technique for automatic syllable parsing based on amplitude exists (Ziegler, Hartmann, & Hoole, 1993). The technique is based on the fact that the amplitude often decreases between syllables. However helpful this may be to count the approximate number of syllables in a spoken string, it is not precise enough because amplitude often decreases in areas other than syllable boundaries and the amplitude often remains constant across syllable boundaries involving sonorants.

It can thus be concluded from this research that no acoustic cue is a good predictor of syllable boundaries in all languages. Some cues may be helpful in some languages but no universal cue has yet been found. This is not surprising since each language implements its phonological structures in a slightly different way. This leads me to discuss the relative importance of syllable structures across languages.

Importance of syllable structures across languages

Before getting into the details of this issue, I would like to comment on a remark make by Lowenstramm (1981). Lowenstramm

distinguishes between the "theoretical" and the "intuitive" syllable, that is "the pretheoretical notion of the syllable to which we refer when trying to characterize performance acts such as the parsing of an utterance or the placement of a hyphen in the end-of-line division of a word." (p. 576). He adds that the two types of syllable do not need to coincide. In reviewing experimental and theoretical articles on the syllables (e.g. Noske, 1981 and Treiman, 1983), it actually becomes evident that there are two different visions of the syllable. One is based on the way people process languages while the other is based on language structure. However, such a dichotomy is artificial and should be rejected. Instead, information should be shared and taken into consideration by adherents from both sides. Indeed, we are studying one single phenomenon from two different angles. Attempts were made in the present thesis to consider both aspects whenever possible.

Languages have been categorized into three rhythm types ever since Pike's classification in 1945. Some languages have their rhythm set by stress patterns (stress-timed languages), some have it set by the regularity of syllables involved (syllable-timed languages), and others have it set by the mora structure involved (mora-timed languages). In other words, the duration of an utterance is determined by the number of stressed syllables for stress-timed languages, by the number of syllables for syllable-timed languages, or by the number of moras for mora-timed languages. Many have criticized this classification since it was done without experimental verification. Others criticize it because some languages cannot be classified according to these rhythm types (Balasubramanian, 1980; Sebastián-Gallés, Dupoux, Seguí, & Mehler, 1992). Nevertheless, parts of the taxonomy have also been confirmed. Furthermore, the theory can be modified according to the findings in various languages instead of being rejected altogether. Finally, it reminds us that not all languages are necessarily best described in terms of the same basic units.

Fant et al. (1991) found that French (a syllable-timed language) has uniform syllable duration over the sentence, as compared to

Swedish and English, which are stress-timed languages and therefore have roughly uniform syllable length between stressed syllables. These results were predicted for French by O'Shaughnessy (1981) and they were partially confirmed by Fletcher (1991). Hoequist (1983) found similar results for Spanish (another syllable-timed language) as compared to Japanese (a mora-timed language) and English. However, we should remember that divergent results have also been found for Spanish (Sebastián-Gallés et al., 1992). Results similar to those of Hoequist (1983) were found by Sato (1993) for Japanese, English, and Korean (a syllable-timed language).

Although Spanish is traditionally viewed as a syllable-timed language, Pointon (1980) argues against this view and claims that the duration of the syllable is to be determined by the number of phonemes and the presence or absence of stress it contains. Pointon's study is a review of previous studies, along with a reanalysis of their data. The hypothesis is contradicted by experimental results obtained by Sebastián-Gallés et al. (1992). Results obtained in three detection tasks clearly show that syllable structures are accessible both in Spanish and in Catalan. However, access to the syllable structures is not essential. Furthermore, subsyllabic units are more easily accessible than syllable structures when subjects are asked to respond very fast. The authors hypothesize that "This subsyllabic stage, however, is transient in nature, so that only extremely fast responses can pick it up" (Sebastián-Gallés et al., 1992: 30). Since Spanish and French are both Romance languages, and since they were both traditionnally viewed as syllable-timed languages, this hypothesis may also be valid for French.

Scott, Isard, & de Boysson-Bardies (1985) claim that the perception of syllable regularity by English and French speakers is not different in their respective languages, and they try to link this to the differences in syllable structures between English and French. They designed an experiment where the task was to tap the rhythm of target sounds in heard sentences. Subjects were French and English speakers,

and the sentences were French and English sentences with four syllable-initial stops irregularly dispersed as target sounds. The sentences were also supposed to have a comparable number of syllables across languages (which was not the case). The target sound was the same all along each sentence, and there were more words starting with stop consonants than with the target sounds. The English target sounds corresponded to the strong syllables of each sentence. Since English is a stress-timed language and French is a syllable-timed language, they hypothesized that English subjects would tap more accurately than French speakers. Instead, they found that both groups of subjects tapped more regularly to French than to English stimuli. They also found that French subjects regularized more than English subjects, and that they were more accurate at tapping non-speech control stimuli. They concluded from these results that either French is a stressed-timed language or English does not have the stress regularity that it is said to have.

In fact, their protocol did not test syllable structure as such. The rhythm tapped was the rhythm of the target sounds and not of the syllables. These results only indicate that French has a rhythm that is perceived as being more regular, and that French subjects have a more regular and more accurate rhythm. There were many more syllables than target sounds in the sentences presented. Thus it is possible that French subjects simply tap the rhythm at a regular tempo just as they would do with music, since all syllables have equal importance in French. This in fact might happen because French does not have the varied stress patterns that English does have.

Wenk & Wioland (1982) also claimed that French is not a syllable-timed language. They based their analysis on results from two studies they conducted. The first of these studies involved 12 native speakers of French reading sentences. Only one of these sentences as read by the 12 speakers was used in the experiment. The duration of the two phrases of the sentence were analyzed. The first phrase had 12 syllables and the second had 6. They predicted that the first phrase

would have a duration **twice** as long as the second one because French is a syllable-timed language, and thus, the number of syllables was proportional to the overall duration of the sentences produced. This prediction was not confirmed: the average duration of the first phrase was not exactly twice the duration for the second phrase. The authors concluded that French was not a syllable-timed language. However, the first phrase was found to be significantly longer than the second phrase by a t-test I performed on the data they presented in the paper: $t = 1.77$, $df = 22$, $p < .05$.

The second experiment they performed was to ask 24 native speakers of French to write the sentences that were presented to them auditorally. Half of the sentences were "rhythmically ambiguous" i.e., sentences that could have a second meaning which could not be discerned by the rhythm. The other half were ambiguous sentences where the ambiguity could be solved by the rhythm. This experiment was designed to "demonstrate" that rhythm was a key factor in French, and indeed, subjects used the rhythm to resolve the ambiguities. It is important to note, however, that syllable structure largely dictates the rhythm of a language, a point that was not addressed by the authors.

Both studies of Wenk & Wioland suffer from serious flaws. The subjects involved in both studies were not described with any precision. "Native speakers of French" is a very vague way to describe subjects which may come from a broad variety of sub-cultures and dialects. French is the national language of over 119 million people in 33 countries (Commissioner of Official Languages of Canada's 1990 annual report). In the first study, the first phrase in the sentence that was read had V and CV syllables exclusively (24 phonemes, 12 syllables, which is especially long), whereas the second phrase had mostly CVC syllables (17 phonemes, 6 syllables) in which the final consonants were voiced, lengthening the preceding vowels. Furthermore, the order of the short and long phrases should have been counterbalanced, since prosody may have an influence on phonemic duration in French (Touati, 1987).

The sentences used for the second study also exhibited obvious flaws: The ambiguity of most of the sentences presented as examples was not complete since one of the meanings was very unlikely in casual uncontextualized speech. Example 3a "Je connais les aulnes" ("I'm familiar with elm-trees") and 3b "Je connais les zones" ("I know the zones") are likely to lead to the second meaning in a free written production by subjects, although they are pronounced the same (rhythmically ambiguous). Example 6a "La moustache tomba" ("The mustache fell off") and 6b "La mousse tache ton bas" ("The foam stains your stockings") are both difficult to imagine in a general conversation. Furthermore, the syntactic group boundaries in these sentences are located at different places. It is thus understandable that rhythm should be different.

It is therefore difficult to take these results seriously. Not only is the methodology poor, but the theory underlying the research is misleading. Indeed, the authors lead us to believe that stress was never considered as an influential factor on duration in French before their study. Stress is known to exist and to be regular in French (Delattre, 1981); however, its importance on duration is thought to be minimal (Crompton, 1980). Until further evidence is found for the claimed irregularity of French syllabification, it does not seem that Wenk & Wioland's results warrant the rejection of Pike's categorization of French as a syllable-timed language.

Although the categorization of languages as stress-timed, syllable-timed or mora-timed is not accepted by all linguists, it remains a viable hypothesis, and can be helpful in limiting the generalization of phenomena from one language to another. However, further experimental support will be required to validate this classification. Partial validation may come from the study of syllable structures of specific languages, although this is clearly not the goal of this thesis. A description of the syllable structure of the two languages mainly concerned by this thesis (a syllable-timed language — French, and a stress-timed language — English) will be presented later, but a

description of the experimental protocols most often used in syllable studies is important to understand how the data were collected. This is the topic of the next section of this chapter.

Experimental protocols for the study of syllable structures

Following is a description of the experimental protocols used for the perceptual study of syllable structure. Production studies (e.g., exp. 3 of Treiman, Gross, & Cwikiel-Glavin, 1992) will not be included here because they fall under a completely different set of experimental protocols. Of course, not all perceptual studies on the syllable were reviewed, but all attempts were made to be thorough and to illustrate the protocols with representative studies. Some protocols (e.g., Treiman, 1988, exp. 1) are not reported here because their results are difficult to interpret without encountering serious problems. Studies bearing on the relative links within the syllable and studies of syllable structure have been combined here because the results of both types of these studies have implications for the other.

Before getting into the description of the protocols, we might notice that all of the protocols to be described except two involve metalinguistic tasks. The *sound-similarity judgment task* and the *global sound-similarity judgment* do not involve a concious metalinguistic decision.

•*Word-blending task* (Treiman, 1983; 1988; Derwing, Dow, & Nearey, 1988; Wang & Derwing, 1994; Derwing, Yoon, & Cho, 1993). In this type of protocol, two meaningless monosyllabic CVC items are presented aurally to the subjects. The task of the subject is to blend the beginning of the first item with the end of the second one, giving a monosyllabic meaningless item ('tis' + 'ral' could become either 'til' or 'tal'). The results indicate the place where the subject breaks the first item, showing the relative strength of each constituent of the syllable. In such a protocol, care should be taken that neither the stimuli nor the possible resulting items have a meaning because semantic factors could play an important role in the results.

•*Syllable reversal task* (Treiman & Danis, 1988a). In this protocol, words (sometimes in a phrase or in a sentence, sometimes alone) are presented aurally to the subjects. The subjects' task is to invert the order of the parts that make up the words ('study' could become 'ystud', 'dystud', 'dystu'). No explicit instructions were given to subjects by Treiman & Danis; the researchers only provided examples and practice items. By inverting words, the subjects indicate where they would divide the words into syllables. It is very important to control the morphemic structure of the stimuli in such protocols.

•*Sound-similarity judgment task* (Wang & Derwing, 1994). The sound-similarity judgment task is a protocol where a monosyllabic word, followed by two monosyllabic words (each sharing either the head or the rime with the first word heard) are presented aurally to the subjects. The subjects' task is to choose which of the last two words most resemble the first word ('bead', followed by 'bean' and 'mead'). The logic behind the protocol is that, if the head of the syllable is a stronger relationship than the rime, the word sharing the head will be favored by subjects. Strict semantic control is important for this protocol.

•*Global sound-similarity judgment* (a variant of the sound-similarity judgment — Derwing, Parkinson, & Beinert, 1993; Wang & Derwing, 1994). The protocol is different in that only two words are presented aurally, and the subjects' task is to rate the degree of global sound-similarity of the two words along a ten-point scale (0 being very different words and 9 being identical words). The logic behind this protocol is the same as that of the sound-similarity judgment.

The next two protocols to be described are under dichotic listening conditions. Dichotic listening is a process where subjects are presented with two different stimuli simultaneously, one in each ear. The perceived result is often a blend of the two stimuli (an auditory correlate to the McGurk effect — McGurk & MacDonald, 1976).

•*Detection task under dichotic conditions* (Kolinsky, Morais, & Cluytens, 1995, exp. 1 and 2). This protocol consists of presenting two meaningless CVCV words simultaneously, one in each ear. A combination of the two stimuli at the predicted syllable cut locus leads to two target words (these stimuli were meaningful in some of the experimentations and meaningless in others). The subjects' task is "... to decide whether the target indicated in the booklet for each particular trial had been presented or not." (p. 25). The logic behind this protocol is that subjects will unconsciously combine the two stimuli into a target that respects the syllable structure of the language. This will be indicated through false alarms, i.e., the subjects decide that a word found in the booklet is heard although it is not. The results in these studies are said to show (among other things) whether or not the syllable is a speech unit with psychological reality in the language under study. However, this assumes that the syllable structure of the language is well known and very regular. In the case of Kolinsky et al. (1995), this assumption is not even explicit. There may be a great risk in doing such an analysis without at least mentioning alternative possibilities. The authors' results indicate a strong syllable effect, corroborating the results presented later in the present thesis.

•*Identification task under dichotic listening* (Kolinsky et al., 1995, exp. 3). The main difference between this protocol and the previous one is that the subjects are asked to name the stimulus heard in one specific ear. Both stimuli are nonsense words, and one of the possible targets is meaningful. The resulting target often corresponds to the expected response but it sometimes involves a collage of the two stimuli (called a "migration"). Migrations indicate (among other things) that the subject parsed the two stimuli at the proper syllable break and recombined two of the syllables to form a meaningful word. The same assumptions and the same comments as in the previous protocol apply here.

•*Timed syllable-detection task* (Mehler, Dommergues, Frauenfelder, & Seguí, 1981; Seguí, 1982; Cutler, Mehler, Norris, & Seguí, 1992;

Sebastián-Gallés, Dupoux, Seguí, & Mehler, 1992). This is a protocol where the dependent variable is the time it takes to detect the syllable. In this protocol, a string (a syllable) is presented visually to the subjects (in front of them) as they hear a series of words. The target word is placed as the second, third, fourth or fifth word in the series. At other times, there are no words that match the string. The task of the subjects is to detect (by pressing on a button) a word that starts with the same sounds as the written string ('BAL' is presented visually and words such as 'radio', 'paper', and 'balcony' are played; the subjects are supposed to press on the button as soon as they hear the word 'balcony'). The strings shown are either CV or CVC syllables; the words heard are meaningful bisyllabic words. The time to detect the words that share the initial string is measured with an accuracy of one thousandth of a second. The logic behind the protocol is that words which share exactly the initial syllable with the written string will be identified faster than words that do not match. This again assumes that the syllable structure of the language is very well known and regular, which is not the case for English, where many factors are known to interact in the determination of the syllable structure. The results of such studies is also difficult to interpret because of vowel reduction, instability in the pronunciation of some consonants in some dialects, lexical frequency, semantic relations, etc.

•*Forced-choice written syllabification task* (Treiman & Danis, 1988a; Treiman et al., 1992). Bisyllabic stimuli are presented to the subjects on a sheet of paper along with choices of possible divisions of these stimuli. The choices here are called the syllable division alternatives. These stimuli can either be meaningless or meaningful words. The subjects' task is to select their favored syllabification ('bacon' can be divided as 'ba-con', 'bac-con', or 'bac-on'). Phonetic and morphological composition of the stimuli are critical in some languages. Spelling also has to be controlled because of the known grapho-phonemic relationship.

•*Forced-choice oral syllabification task*, a variant of the last protocol, also known as the *pause-break experiment* (Treiman et al., 1992; Derwing, 1992). In this variant, both the stimuli and two or more alternative syllable divisions are given orally, and subjects indicate their choice by either answering orally or by filling in a multiple-answer sheet. This version of the protocol was developed to allow testing with analphabetic subjects. The same controls have to be used as in the written version of the protocol, even the spelling controls.

•*Forced-choice oral/written syllabification task* (also a variant of the last two protocols — Treiman & Zukowski, 1990). In this variant, the stimuli are read aloud and the alternative syllable divisions are written on an answer-sheet. The same controls have to be used as in the written and the oral version of the protocol.

These protocols have mostly been used to study English syllable structure, although some research dealt with French (Kolinsky et al., 1995, among others). The results given by them is summarized in the next section. Combined with these is non-experimental work that provides important information about the syllable structure of French or English.

Specific English and French syllable structures

The French syllable is generally said to be fairly regular. It should be noted that most of the research providing a description of French syllables was done using sonority scales to establish syllable parsing loci, whereas the research done on English syllables was done with perceptual experiments (except for studies by Delattre & Olsen, 1969, on English). Using sonority scales to try to describe the preferred syllable constitutes a problem because the only information the scales provide is that a certain segment is more or less likely to be placed closer to the nucleus of the syllable than another consonant. With sonority scales, there is no way to know whether or not a given single consonant will be the coda of a syllable or the onset of the next one. Another problem with studies on the French syllable is that they also

include phrase-final syllables. In other words, some of the syllables that were counted as closed syllables were at the end of phrases or sentences and they could not have been part of the onset of the next syllable. These studies do not exclude the possibility that single intervocalic consonants could constitute both the coda of a syllable and the onset of the next syllable.

The sonority hierarchy (one of the bases of syllabification according to Treiman & Zukowski, 1990, Delattre, 1940, 1944a and 1944b) is most frequently displayed as follows (Delattre, 1940), in increasing order:

stops ⇒ nasals ⇒ fricatives ⇒ liquids ⇒ glides

The rules based on sonority are not entirely satisfactory because they do not explain certain syllable formations. For example, Ohala & Kawasaki (1984) mention that "although initial sequences of the sort /bl, gl, dw, gu, gʷa, gja/ are common enough, /dl, bw, bu, gʷu, gji, wu, ji/ are systematically excluded in a great number of languages." (p. 122). Furthermore, consonant strings such those found in the onset of /stɹits/ (where the /s/ has a higher sonority than the /t/) are found both word-initially and syllable-initially in English. /st/ clusters are frequent in English although they do not respect the second rule given by Treiman & Zukowski, whereby there must be an increase of sonority toward the nucleus of the syllable. Although the /st/ cluster does not respect the sonority rule, the acoustic differences between the /s/ and the /t/ are considerable and their contact does not lead to confusion. Ohala & Kawasaki suggest that languages will use the sequences of phonemes that allow the maximal differentiation and if these are not enough, sequences that involve less modulation will be used "after the better ones have been fully exploited." (p. 123). Some languages have phonotactic constraints concerning the initial /st/ cluster; it is not allowed in Spanish, for instance. The vowel /ɛ/ will be inserted at the beginning of the word and a resyllabification will happen, breaking the cluster. Delattre (1940) claims that the word-internal /st/ cluster in

French will be split if possible. This rule will be discussed further in chapter four.

The next two paragraphs describe results obtained by Wioland (1985). His analysis was done by parsing interviews using an undescribed method. It is believed that the division was done following rules developed for pedagogical purposes, such as the ones given by Delattre (1940; 1944a; 1944b).

The structure of more than 80% of the syllables in French is (C)V, the so called "open syllable". As shown by Wioland (p. 260), the most frequent syllable structure is the CV structure which is found in more than 55% of the syllables, followed by both the CCV structure and the CVC structure in about 14% each, the V structure in about 10%, and the CCVC structure in 2.65%; the remaining structures are found in less than 2% each.

Furthermore, only a limited number of consonants can occur as the coda of a closed syllable. The most frequent are /R/ and /l/, which, together, occur in more than 50% of the cases. The codas /z/ and /s/ are found in a number of cases, but together they represent less than 15%. Other consonants occur in a significant number of syllables together but are barely significant on their own. For example, /t/ (one of the most frequent of these) represents 7.5%. Syllables ending with a consonant cluster constitute only about 2% of the syllables.

Delattre (1940; 1944a; 1944b) studied intervocalic consonants and consonant clusters in order to determine in which cases a consonant cluster will be split into two groups, one for the coda of the preceding syllable and one for the onset of the ongoing syllable. The analysis of Delattre has been selected here in favour of others (Dell, 1995, among others) because Delattre studied a larger set of environments and the rules he presented are simpler. Various factors were found to be important: the degree of sonority and the degree of aperture of the consonants, their strength of articulation, the direction

of the articulatory movement from one consonant to the other, the difference in the place of articulation, and the stress pattern (Delattre, 1940). The degree of sonority of the consonants seems to be the main factor (Delattre, 1944b). Presumably, the sonority of the components of a syllable should rise toward the nucleus and fall following it. Thus, if a consonant cluster precedes the nucleus, the first consonant should have a lower sonority than the second consonant of the cluster, which should also be lower than the sonority of the third consonant, if there is one. But as Delattre pointed out; "notwithstanding the other rules, it is easier to separate two consonants than to pronounce them together" (1940: 154 — personal translation), which explains the small number of syllable-final consonant clusters found in Wioland (1985).

Another study of French syllable structure is worth mentioning: Laeufer (1991) claims she studied the syllabification of French from both an acoustic and a perceptual point of view. She asked 10 French "native-speakers" to read a list of French words slowly and fast in different conditions and she asked them to indicate the number of syllables in each stimulus. She then performed an acoustic analysis and compared it to the syllable count data and the theoretical predictions of syllable divisions. In my opinion, this study is seriously flawed in many respects. First, very little information was given on the methodology. No information about the regional and dialectal origin of the subjects is given, nor any accounts of the potential bilingualism of the subjects. The researcher is located in Ohio, an American state with almost no native French speakers. No details on the selection of the stimuli were provided and no details on the way the acoustic analysis was performed. Second, too few stimuli of each syllable structure were used; in some categories, as few as two items were used. Third, the analysis of the results suggest four false premises. (1) Acoustic cues are said to have been isolated for French, which is not correct as we rewiewed in the section, *The acoustic cues to acoustic parsing* , starting on page 11 of the present dissertation; (2) the number of syllables counted by the subjects was said to be consistant, which is not correct because some of the stimuli were spelled with a mute-e at

the end and some but not all subjects counted it as a syllable: (3) words such as "somnifère" /sɔmnifɛR/ were said to have a clear acoustic division between the /m/ and the /n/, which is unlikely because they are both nasal stops and no clear break occurs between them; and (4) providing a syllable count of stimuli was said to provide information about the loci of syllable division preferred by the subject, which is not correct, since counting syllables provides no information on the syllable boundary loci. Because of all these flaws, the results of Laeufer (1991) will not be considered in the present thesis.

Research done on the English syllable (Treiman & Danis, 1988a; 1988b; Derwing, 1992; Derwing, Dow, & Nearey, 1987; Treiman, Straub, & Lavery, 1994) established that English syllable structure is influenced by a variety of factors: vowel quality, stress pattern, type of medial consonant, and number of letters used to represent the medial consonant in spelling.

The internal structure of the English syllable has been analyzed experimentally to test some theoretical models such as that proposed by Treiman (1983) and Selkirk (1982). In these models, the syllable has two major parts: the onset, which consists of consonants preceding the nucleus of the syllable, and the rime, which includes the nucleus and optionally the consonant(s) following it. Treiman and collaborators (1983; 1986; 1988; 1990; 1992; 1994) showed that the English syllable has an onset/rime structure. Yaniv, Meyer, Gordon, Huff, & Sevald (1990) also found that the rime is an integral sub-syllabic unit in English, and Derwing, Dow & Nearey (1987; 1988) found that the vowel has a stronger link with the coda than with the onset. Bowey (1993) found similar results in written tests. Levitt, Healy, & Fendrich (1991) did not find this effect, but their results may have been influenced by the fact that they used visual instead of auditory stimuli. Anderson & Port (1994) found results supporting autosegmental and hierarchical syllable models but not traditional linear segmental models of the syllable.

Treiman & Zukowski (1990) stated three rules governing the syllable structure of English: (a) stressed vowels attract the following consonant; (b) sonority must rise to the nucleus and fall to the coda, that is, the onset and the coda must have a lower sonority than the nucleus, and if the onset or the coda consists of a consonant cluster, the consonant closest to the nucleus must have a higher sonority than the farthest one; and (c) consonant clusters must be acceptable word-initially to be able to appear syllable-initially, and must be acceptable word-finally to be able to appear syllable-finally. In addition, consonants are more likely to be lost, added or mispronounced if they appear as the first consonant of a cluster (Stemberger & Treiman, 1986).

This brings me to the description of the goals and the hypotheses of the thesis. Because the thesis bears on two questions that are related but quite distinct, I will present the goals in two different parts. As the reader will realize, verification of the second set of hypotheses is dependent on the first set of hypotheses.

First goal: understanding French syllabification

As mentioned before in various sections of this introduction, the syllable structure of French has been said to be fairly regular (Cutler et al., 1986; Delattre, 1940, among others). This "regularity" has, however, never been experimentally studied. Although experimental verification of everything is not necessary, it is rather simple to provide in this case, and it would add validity to the "rules" that were set to describe French syllabification. This section provides a summary of the syllabification rules for French and describes the extent to which some of them are expected to be applied by the subjects. Finally, a brief description of the experimental design used to test this first set of hypotheses will be given.

As indicated on page 29 of the present dissertation, Wioland (1985) showed that the most frequent syllable structure is the CV structure. Wioland's data do not consider word position. Overall,

however, syllable sequences with a single intervocalic consonant are the most frequent ones, followed far behind by syllables with an initial consonant cluster. These syllable-initial consonant clusters involving O + /R/ are six times more frequent than other clusters (in relative frequency), followed by O + /j/ clusters, which are three times more frequent than other clusters. Dell (1995) studied the theoretical structure of the possible consonant clusters of French. Despite the fact that he proposes a deeper analysis than Wioland, the conclusions of Dell and Wioland are similar. Specifically, Dell suggests a rule according to which only one consonant can occur in the coda, except for O + liquid clusters, which he considers an indivisible group.

Some potential clusters are generally underrepresented by Wioland's results because of the parsing techniques used. Intervocalic /st/ clusters were split. Delattre suggests splitting this kind of cluster because the sonority of the first consonant is higher than that of the second one (1940). However, this cluster is found word-initially and could thus appear syllable initially (a principle supported by Pulgram, 1970, Treiman & Zukowski, 1990, and Dell, 1995).

The syllabification rules proposed by Delattre can be summarized as follows — I will only discuss the bisyllabic cases here but the same rules apply to longer words:

(a) a single intervocalic consonant is syllabified as the onset of the second syllable, leaving the first one without a coda (open syllable);

(b) for a consonant cluster, preference is given for splitting the cluster. However, some clusters are not split according to other rules:

(b-1) a cluster is kept together if the sonority of the first one is clearly lower than that of the second one;

(b-2) if the first consonant is pronounced in the front of the mouth and the second one in the back, the cluster will tend to stay together, provided that b-1 is respected.

These guidelines have "ruled" French syllabification ever since they were suggested for pedagogical purposes. In general, they tend to respect intuitions about the French syllable and that is certainly why no one questioned them. Their success in French L2 classes is well established. However, because the syllable divisions following the application of these rules are assùmed to be correct by some researchers (Mehler, Dommergues, Frauenfelder, & Seguí, 1981; Seguí, 1982; Cutler, Mehler, Norris, & Seguí, 1992; Sebastián-Gallés, Dupoux, Seguí, & Mehler, 1992), and because some syllable structures may be incorrect (e.g., the word medial /st/ clusters), it is important to test experimentally the well-foundedness of the syllabification rules.

The experiments presented in the next chapters are attempts to better understand French syllable structure. The hypotheses are made explicit at the end of this chapter. The first two experiments deal with the single intervocalic consonant (CVCV), structures which are the most common (Wioland, 1985). They involve L1 and L2 speakers of French — the L2 aspect will be discussed in the next section of this chapter. The last experiment studies several syllable structures from an L1 perspective.

All three experiments are forced-choice oral/written syllabification tasks (henceforth called the pause-break experiment, after Derwing, 1992, even though it is a variant of Derwing's protocol). All of the experiments were done on a computer to ease the process and to avoid transcription of the data. Using a computer also allows randomization of the items without introducing variation in their pronunciation.

The first experiment had two goals: (a) to collect data on the syllable structure of CVCV items; (b) to test whether the results are

influenced by the presentation mode of the syllable division alternatives — oral, written, or oral and written. The number of letters used to spell the single intervocalic consonant was also measured for reasons explained below. Based on the results obtained in the first experiment, the stimulus items are given orally and the syllable division alternatives are given in writing in the last two experiments. The goals of the second experiment were (a) to collect extensive data on the syllable structure of CVCV items, and (b) to test whether or not L2 speakers syllabify differently from L1 speakers. The goal of the third experiment was to expand the knowledge gained in the first experiments to other syllable structures, namely stimuli with the following structure: CVCV, CVPPrV, CVPrV, CVsPV (where P is a plosive or stop).

Furthermore, orthographic and phonological representations are well-known to interact closely (see Beaudoin, 1989 for a summary of the issue). Syllable divisions may therefore be influenced by the spelling of the intervocalic consonants. This tendency is augmentated by the fact that some techniques used to teach reading explicitly instruct learners to read a single intervocalic consonant spelled with two letters (a doublet) as ambisyllabic. An ambisyllabic consonant is a single intervocalic consonant that is syllabified both as the coda of one syllable and the onset of the following one. The extent of effect on the pronunciation of such a factor has not been studied and goes beyond the scope of the present thesis. The effect of doublets on the syllabification of French words will, however, be measured in the first experiment to be presented and controlled in the following ones.

Various characteristics of the vowels and the consonants involved in syllables have also been reported to influence syllabification in English (Derwing, 1992; Treiman & Danis, 1988a). Delattre mentions some of the consonantal effects of clusters in French. It is therefore important to measure such factors. This will be done systematically in the second experiment.

As implied earlier, L2 speakers of French may also behave differently from L1 speakers, that is, L1 and L2 speakers may syllabify differently. This phenomenon of interference is predicted by a contrastive analysis and it will be explained in the next section.

Second goal: establishing the presence of L1 interference

Interference occurs when a speaker of Lx learns another language Ly and makes errors because the prior knowledge in Lx comes to influence Ly (Brière, 1966; Eliasson, 1984). Errors are theoretically predictable by comparing the phonological structure of the two languages; this technique is called contrastive analysis. The strong position on contrastive analysis states that knowledge of the phonological structure of two languages makes it possible to predict the errors that will be committed by native speakers of one language when learning the other one. However, evidence shows that differential phonological structures cannot always predict acurately actual language learning difficulties (Kohler, 1981; Brière, 1966). Even classes of sounds such as clicks that are absent in one language (English) but present in another (Zulu) can be learned with few or no errors (Best, McRoberts, & Sithole, 1988). Brière (1966) and Kohler (1981) explain that phonology is inappropriate for such predictions; phonetic characteristics must be taken into consideration, and a distinction between perception and production must be respected.

In one of the previous sections of the present chapter, the differences in syllabification between English and French were discussed. It is evident that the syllable structure of the two languages differs at the phonological level, especially when one considers the presence of complex stress patterns in English and the predictability of the phrase-final stress of French (Gendron, 1973; Walker, 1984). However, it is difficult to study the phonetics of the respective syllable structures because no reliable acoustic cues to syllable parsing have been found. The predictions regarding the potential syllabification errors of L2 learners have to be based on phonology, at the risk of being wrong. However, as pointed out by Trammell (1993), the

phonetic errors that may be caused by a faulty syllable structure are numerous (see specifically pp. 215-217).

Previous research has studied syllable structure in L2. One example, a pilot study by Tarone (1980), showed that L2 syllable structure is influenced by L1 syllable structure. The study involved a small sample of subjects and the conclusions are pushed further than the data allow. The second one (Sato, 1984) was a case study on the production of English by two Vietnamese boys that supports the notion of L1 syllable structures being transferred to L2 as a step in language learning.

Based on these two studies, it is possible to assume that L2 learners will syllabify the target language differently from native speakers of that language, and that the difference will go in the direction of that L1. To allow such a comparison, various groups of subjects were involved in the second experiment to be described later in the present dissertation, where stimuli in English and in French were used. Groups of English monolinguals and French monolinguals were included to establish a "standard" for their respective L1. Their syllabification of the other language — that they did not understand — should be almost entirely based on their L1 syllable structure. Groups of English-dominant bilinguals and French-dominant bilinguals were included to test the hypothesis based on contrastive analysis. Their syllabification of L2 should show the effects of the syllable structure of both French and English (interlanguage). The last group was composed of balanced bilinguals to analyze whether they treated the syllable structure of both languages differently.

This concludes the introduction of the present thesis. The hypotheses for each experiment are listed below. It is expected that these hypotheses will have to be modified as results from the first and second experiment are analyzed. The specifics of each experiment will be found in the next chapters.

Hypotheses

Experiment one: Syllable parsing of bisyllabic words presented aurally and visually

H-a. Results for the three versions of the forced-choice syllabification task should not be significantly different.

H-b. French speakers divide CVCV French stimuli before the intervocalic consonant when the consonant is spelled with a single letter (singlet). Variation is possible with doublets.

H-c. English speakers of French as L2 divide CVCV stimuli in a way different from L1 speakers. The difference should go in the direction of the syllabification of English.

Experiment two: Syllable structure of French and English as first and second languages.

H-d. French monolinguals divide CVCV stimuli before the intervocalic consonant when the consonant is spelled with a single letter.

H-e. English speakers of French as L2 divide CVCV stimuli in a way different from L1 speakers. The difference should go in the direction of the syllabification of English.

H-f. English monolinguals should divide English stimuli in a way that is compatible with previous studies (Derwing, 1992, among others).

H-g. Balanced bilinguals divide English stimuli as English monolinguals do and French stimuli as French monolinguals do.

Experiment three: Specific syllable structures of French presented aurally and visually

H-h. French speakers divide CVCV stimuli before the intervocalic consonant when the consonant is spelled with a singlet (a control part of the experiment).

H-i. CVPPrV stimuli are to be divided between the two stops (another control, since other divisions would be an aberration).

H-j. CVPrV stimuli are to be divided before the 'Pr' cluster, a cluster considered strong.

H-k. CVsPV stimuli are mainly to be divided between /s/ and the stop, with some variation is to be expected.

Chapter 2

Syllable parsing of bisyllabic words presented aurally and visually

Introduction

The primary goal of the present experiment is to test whether the perceptual channel used to input the syllable division alternatives of French influences the syllabification of these words (hereafter called the presentation mode). A secondary goal is to acquire experimental data on the syllable division of CVCV French words. A third and less important goal is to test whether L2 learners syllabify differently from L1 speakers of French. Before describing the experimental protocol followed in this experiment, I will review the theoretical aspects of the problem at hand. I should mention that in many respects, this experiment is a pilot study for the experiments presented in the following two chapters, in case any adjustments are required in methodology. One has to keep in mind that this is the first experimental verification of the syllable structures proposed by Delattre (1940; 1944a; 1944b).

Wioland (1985) showed that more than half of the French syllables are CV syllables. Despite the fact that his results were partially biased by his parsing technique, these results indicate the prevalence of this structure in French. That is why I chose to start investigating the French syllable with this structure. Another factor that influenced this choice is that Delattre (1940; 1944a; 1944b) clearly stated that, in a bisyllabic word, a single intervocalic consonant is normally syllabified as the onset of the second syllable. This "rule" has been taken for granted ever since by linguists, as well as by French L1 and L2 teachers. This tendency to leave syllables open is correlated

with the impression of regularity in the rhythm that led Pike (1945) to classify French as a syllable-stressed language.

There is no obvious reason to think that the syllable division proposed by Delattre (1940; 1944a; 1944b) is wrong. However, there are indications that it is not consistently respected in Canadian French. This dialect of French has a high-vowel laxing rule that applies with almost no exception to syllables that have a non-lengthening consonant as coda (Gendron, 1966). In some regions of Canada, some words appear as though they break this rule: "syllabe" [sɪlab] is probably the most evident example. Because no morphological effect could be involved in this case, it is possible that the laxing observed here may be caused by an ambisyllabic /l/. The ambisyllabicity is most likely the result of the doublet "ll" spelling, a phenomenon reported in Treiman & Danis (1988a) and Derwing (1992) for English. The syllabification of intervocalic consonants in French by L1 speakers is thus predicted to follow Delattre's basic rule but to be influenced by other factors which will be described later in this chapter.

In English, ambisyllabicity is common in a number of phonetic contexts (see Kahn, 1976, and Trammell, 1993, for an in-depth study of ambisyllabicity in English). Some consonants are more prone to ambisyllabicity than others (Derwing, 1992), and the stress pattern of the words also influences this phenomenon (Treiman & Danis, 1988a). Overall, English syllable structure is influenced by five main factors:

(a) Stress is the major factor in English syllabification (Treiman & Zukowski, 1990; Derwing, 1992; Treiman & Danis, 1988a). A stressed syllable will tend to attract as many consonants as possible to itself.

(b) The phonetic category of the intervocalic consonant is another primary factor (Treiman & Zukowski, 1990; Derwing, 1992; Treiman & Danis, 1988a — this factor is here called the "manner of articulation"). As a general rule (and notwithstanding other

factors) the less sonorant the consonant, the less ambisyllabicity is likely to occur.

(c) The tenseness of the vowel preceding the intervocalic consonant is also an important factor (Derwing & Nearey, 1991; Treiman & Danis, 1988a). Consonants tend to "stick" to lax vowels.

(d) The number of letters used to spell the intervocalic consonant is important for syllabification: the intervocalic consonant tends to be parsed as ambisyllabic if it is spelled with two letters (Treiman & Zukowski, 1990; Derwing, 1992; Treiman & Danis, 1988a).

(e) The place of morphemic division was also found to be influential on the syllable division (Derwing, 1992): the root is usually kept intact, whether the intervocalic consonant occurs in the first or the second syllable.

These findings about English syllabification are important in two respects: First, they allow us to isolate potential factors that may influence French syllable division, and, second, they inform us on the syllable structure of English speakers in their L1. This is essential if an inference is to be drawn about the transfer of phonological information from L1 to L2, as in performing a contrastive analysis. Indeed, it is generally understood that phonological (or phonetic for some) information from L1 will interfere with the mastery of pronunciation of L2 (Trammell, 1993; Sato, 1984; Tarone, 1980; Kohler, 1981; Brière, 1966; Brière et al., 1968). Thus, the syllable structure of English is predicted to interfere with the acquisition of the syllable structure of French when learning this language. The syllable divisions preferred by anglophones learning French should be reflected by producing different patterns of division in French, and these patterns should resemble English syllabification.

Of course, this supposes that we know the French syllable preferences; the syllable rules from Delattre will be tested with French

speakers. This testing will involve some of the factors found to be important for English, but the size of the stimulus list used in the present experiment does not allow accurate verification of all factors. And, of course, the stress effect is not a concern here since French does not have word stress, as English does. I have prioritized the effect of the number of letters to be controlled. This factor may also be important for French syllabification because of the possibility of ambisyllabicity underlying the laxing of high vowels in some contexts of Canadian French. Syllabification is thus predicted to be different for single-letter and double-letter spellings of intervocalic consonants (henceforth called singlets and doublets, respectively). The manner of articulation of consonants will be recorded but not controlled systematically.

One of the main reasons the stimulus list used in the present experiment could not be very long is that its primary goal was to test whether the perceptual channel used to input the syllable division alternatives influences the syllabification of these words. Having to present the list three times, a long list would have made the experiment much longer. We know that syllable division is influenced by spelling (Derwing, 1992), just as are most phonological phenomena observed in literate populations. The problem here is whether presenting the syllable division alternatives aurally will yield different syllabifications than presenting the syllable division alternatives visually (a combination of the two presentation modes may also lead to different patterns of results). A visual presentation is more efficient because the subject does not need to wait to listen to all of the choices (three in all), and because the experimenter does not have to record and digitize the audio version of the choices. Furthermore, the audio presentation of the choices is also more demanding on the subject's memory because the choices have disappeared by the time the subject responds, whereas, with the visual presentation, the choices remain present. For aural presentation, it is also more difficult to ensure consistency among the recorded stimuli. Previous studies have used

either version of the forced-choice syllabification task, and no obvious differences were reported. It is thus predicted that the mode of presentation will not lead to differential results in syllabification.

To summarize the predictions based on the studies reviewed, here are the three conflated hypotheses that will be tested in the present experiment:

H-a. Results for the three versions of the forced-choice syllabification task should not be significantly different.

H-b. French speakers divide CVCV French stimuli before the intervocalic consonant when the consonant is spelled with a single letter (singlet). Variation is possible with doublets.

H-c. English speakers of French as L2 divide CVCV stimuli in a way different from L1 speakers. The difference should go in the direction of the syllabification of English.

Methodology

Subjects

The experiment involved the participation of 14 volunteer participants. The average age of the subjects was 23.7 years ($\sigma = 7.07$; min.: 18, max.: 40). There were 3 men and 11 women. All subjects were university students registered at Faculté Saint-Jean, the French faculty of the University of Alberta. All subjects were native-born Canadians and subjects were to some extent French-English bilinguals. Dominance for either of the two languages was assessed by general self-evaluation by the subjects using a scale from 1 to 7 (1 meaning nil and 7 meaning perfect — Hamers & Blanc, 1989). Even though a self-evaluation on four points for each language (production and comprehension for both oral and written language) might be more accurate, a general self-evaluation is sometimes more interesting because it involves the identity of the subject. The identity component is lost in the details of the specific self-evaluation, and it was shown to be important to take it into consideration in other situations (Cutler et

al., 1992). The value obtained for the self-evaluation of English was subtracted from the value obtained for French to provide the French-dominance score. Based on this score, eight subjects were English-dominant and six were French-dominant. None of the subjects had received any corrective phonetic training. The results of the dominence scores were as follows:

Table 2-1: Means and standard-deviations for the self-evaluation scores (maximum score is 7):

Group	French rating	English rating
French dom. bilinguals (n = 6)	6.3 (σ = 0.47)	3.0 (σ = 1.73)
English dom. bilinguals (n = 8)	4.3 (σ = 0.66)	6.5 (σ = 0.71)

Material

A list of 41 CVCV common French words was drawn up according to the following rules: the initial consonant and the final vowel were not controlled; about eight words for each of the following intervocalic consonants were isolated: /R/, /t/, /l/, /n/, /s/; half of each of the subsets were spelled with two identical letters (doublets) and four were spelled with one letter (singlet). "pané" was initially misspelled as "panné" and was corrected before being presented to the subjects, explaining the disproportion between singlets and doublets. Also, only three doublets with 'r' were included in the list.

Table 2-2: List of stimuli for experiment one

balai	ballon
Mali	collé
relais	mollet
salon	pollue
béni	connu
canoe	sonnant
menu	tanné
pané	
tenu	
baril	curry
courue	jarret
feront	leurrer
Paris	
sera	bossu
ceci	cassette
deça	Messie
ranci	passé
récit	tissu
bateau	battu
matin	dattiez
patin	guetter
vêtu	mettons

The stimuli were recorded individually in a random order by a male French native speaker from Québec and recorded in a sound-attenuated room on a Tandberg TCR 522 tape recorder with an omnidirectional Sony ECM 50 microphone on a TDK-SA cassette. The stimuli were digitized at 11KHz with SoundEdit using a MacRecorder digitizer with no additional filters. In order to insure regular presentation of the oral stimuli, care was taken to leave less than 1 ms of silence at the beginning and at the end of the digitized stimuli.

The experiment was prepared using a Hypercard stack especially designed for the study and run on a Macintosh SE. The subjects listened to the stimuli through Sony DR-7 headphones set on

monophonic binaural mode. Each subject was tested individually in a quiet room.

Procedure

After reading the initial instructions in French (see appendix) and putting on the headphones, the subjects were asked to enter personal information (name or pseudonym, age, general proficiency in French, general proficiency in English, sex). They were told that they would not have to enter their real name, since whatever they entered would be converted to a numbered code. Then the experiment started. For the three presentation modes, the task was to choose the division that best represented the way the subject would divide the target word. The order of presentation of the modes was chosen at random for each subject, and the time required to do each mode was recorded. The order of presentation of the list within each of the modes was randomized and so were the orders of the syllable divisions alternatives for each subject. The same stimuli were used for all three parts of the experiment but in random order. It took about 45 minutes for each subject to do the entire experiment.

All three presentation modes had the same basic structure: Specific instructions were presented first (while the list was being randomized), an example chosen at random was taken from the list, more instructions were given in order to make sure that the subject was ready to begin, then the presentation started. There was a one-second break after each response. The target word was always played first without visual reinforcement.

The presentation of the visual mode was organized as follows: for each item, the syllable division choices were shown in three boxes placed on the screen at the same time that the target word was played (as shown below). Subjects was able to select the prefered syllable division by clicking on the appropriate box, taking as much time as necessary.

The presentation of the audio mode was organized as follows: For each item, the target word was played, the computer waited 2 seconds, played "a", waited 1/3 second, played the first syllable division, waited another 2 seconds, played "b", waited 1/3 second, played the second syllable division, waited another 2 seconds, played "c" , waited 1/3 second, then played the third syllable division. For each item, the letters "a", "b", and "c" were shown in three boxes placed on the screen at the same time as the target word was played. It was impossible for the subject to answer before all three syllable division alternatives had been heard, but the response rate was again self-paced.

The presentation of the audio-visual mode was a combination of the two above and was organized as follows: For each item, the target word was played at the same time as the syllable divisions were shown in three boxes proportionally placed on the screen. The computer waited 2 seconds, played "a", waited 1/3 second, played the first syllable division, waited another 2 seconds, played "b", waited 1/3 second, played the second syllable division, waited another 2 seconds, played "c", waited 1/3 second, then played the third syllable division. For each item, the syllable divisions were shown in three boxes placed on the screen at the same time as the target word was played but it was impossible for the subject to answer before all three syllable division alternatives had been heard.

Results

The dependent variable under study was the choice of syllable division alternatives preferred by each subject for each stimulus in each presentation mode. It took on average of 322 seconds to complete the experiment in the visual mode, 793 seconds in the audio mode, and 855 seconds in the audio-visual mode. A F-test showed that there was a small but significant difference in the type of syllable division preferred accross the three modes of presentation ($F(2, 1673) = 3.508$, $p = .0302$). However, a chi-square test done on the data showed no significant differences. In any case, the differences were slim; this becomes clear by looking at the specifics of Figure 2-1. The main

difference was that the visual mode led to fewer CV and greater ambisyllabic judgments than the two other modes. This difference is so small that it can be ignored, but it should be remembered that there might be a slight underestimate of CV judgments (a division before the intervocalic consonant — CV.CV) and an overestimate of ambisyllabic judgments (a division that maintains the intervocalic consonant as the coda of the first syllable and the onset of the second one — CVC.CV) with the visual mode of presentation. (CVC judgments constitute a division after the intervocalic consonant — CVC.V.)

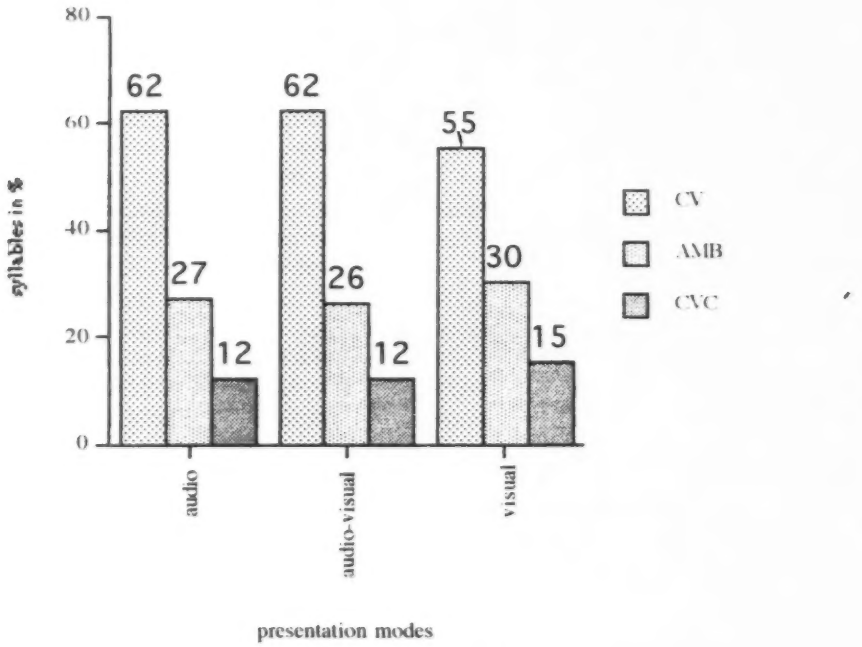

Figure 2-1: Syllable divisions by presentation modes

There was, however, a significant difference in the preferred syllable division between the French-dominant bilinguals and the English-dominant bilinguals ($F(1, 1674) = 4.433$, $p = .0354$). English-dominant bilinguals ($n = 8$) divided CVCV stimuli as CV in 63% of

the cases (e.g., "Ma-li"), as ambisyllabic in 18% of the cases (e.g., "Mal-li"), and as CVC in 19% of the cases (e.g., "Mal-i"). French-dominant bilinguals (n = 6) divided them as CV in 55% of the cases, as ambisyllabic in 40% of the cases, and as CVC in 4% of the cases, as shown in Figure 2-2.

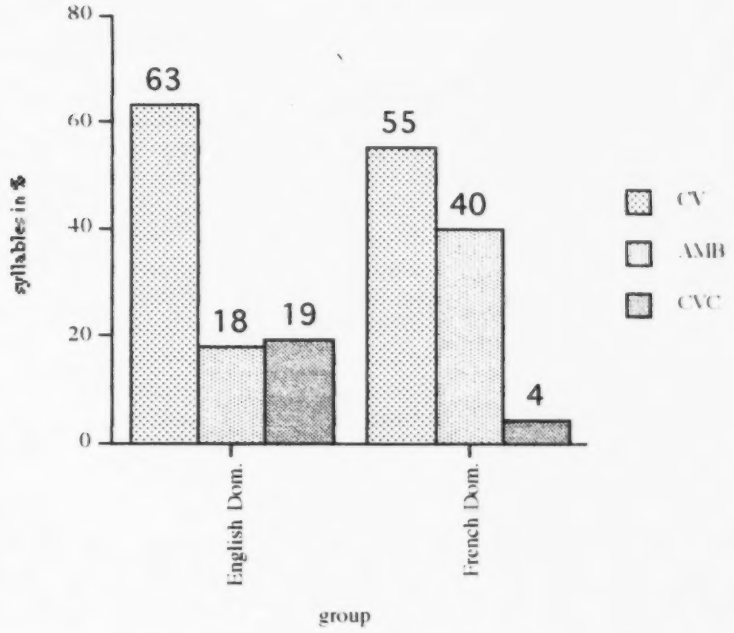

Figure 2-2: Syllable divisions by group

Furthermore, we find that the number of letters used to spell the medial consonant had a stronger effect for French-dominant bilinguals than for English-dominant bilinguals. Indeed, for English-dominants, doublets led to 30% of ambisyllabic judgments, 47% of CV judgments, 23% of CVC judgments, whereas singlets led to 8% of ambisyllabic judgments, 76% of CV judgments, and 16% of CVC judgments. For French-dominants, doublets led to 73% of ambisyllabic judgments, 21% of CV judgments and 6% of CVC judgments, whereas singlets led to 12% of ambisyllabic judgments, 85% of CV judgments,

and 3% of CVC judgments. The number of letters used to spell intervocalic consonants led to significant differences in both groups ($F(1, 718) = 364.265$, $p = .0001$ for French-dominants and $F(1, 954) = 50.667$, $p = .0001$ for English-dominants. See Figures 2-3a and 2-3b).

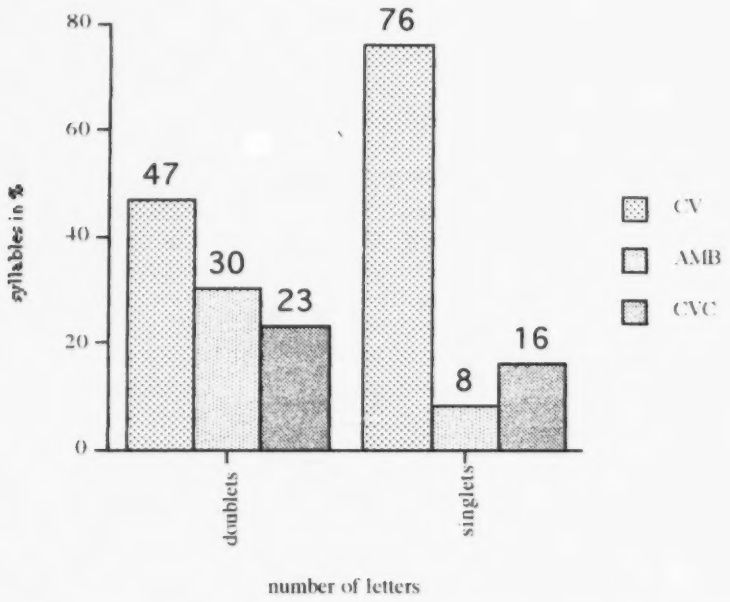

Figure 2-3a: Syllable divisions by number of letters for English-dominant bilinguals

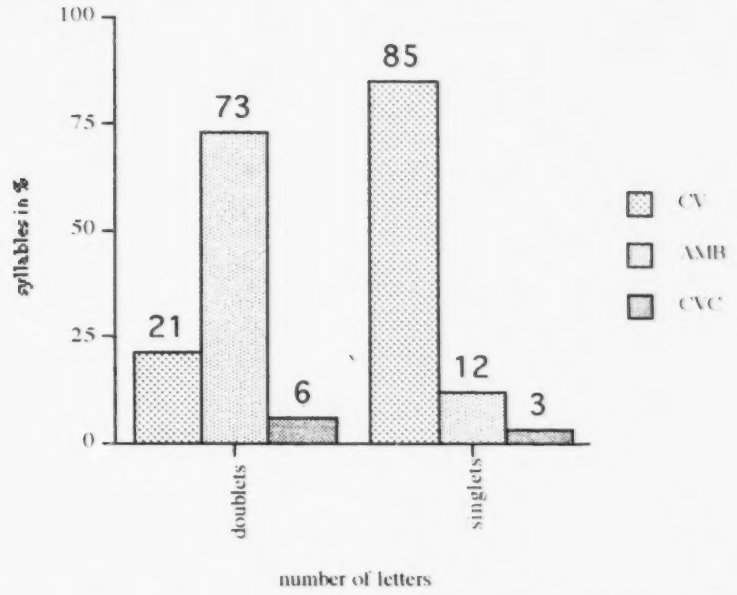

Figure 2-3b: Syllable divisions by number of letters for French-dominant bilinguals

An analysis was performed on the intervocalic consonant to test for a potential phonemic effect. For English-dominant bilinguals, all singlets were divided predominantly as CV syllables with very little variation from one phoneme to the next, although the proportion of CV judgments was lower than for French-dominant bilinguals. The results for doublets in English-dominant bilinguals were unclear, except for obstruents (/t/ and /s/), where more than 55% of the syllables were divided as CV. For French-dominant bilinguals, all singlets were divided predominantly as CV syllables and all doublets were divided predominantly as ambisyllabic judgments, with very little variation from one letter to the next. See Figures 2-4a and 2-4b.

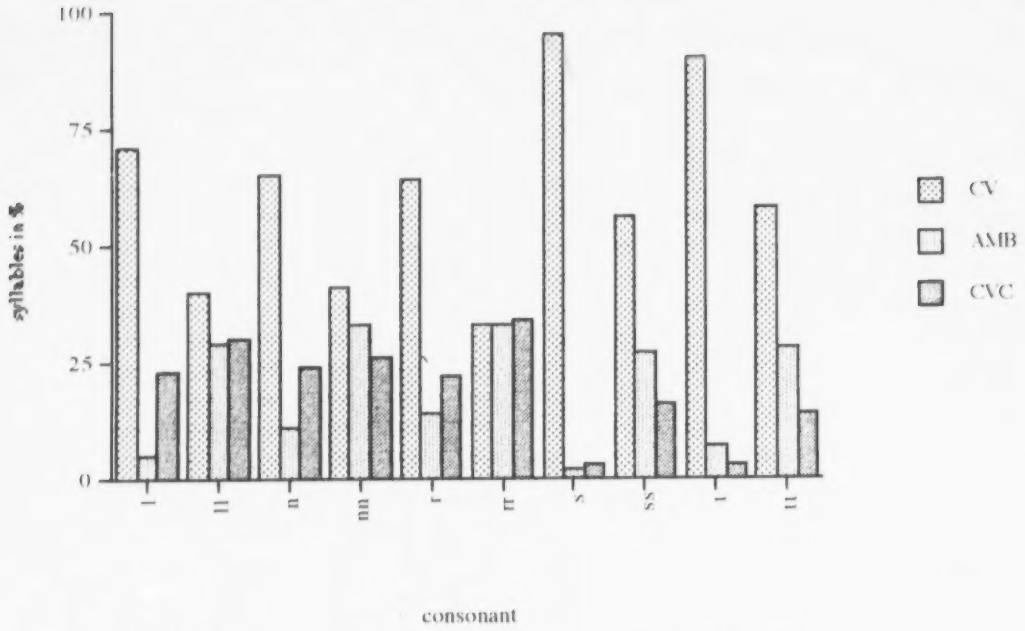

Figure 2-4a: Syllable divisions by letter for English-dominant bilinguals

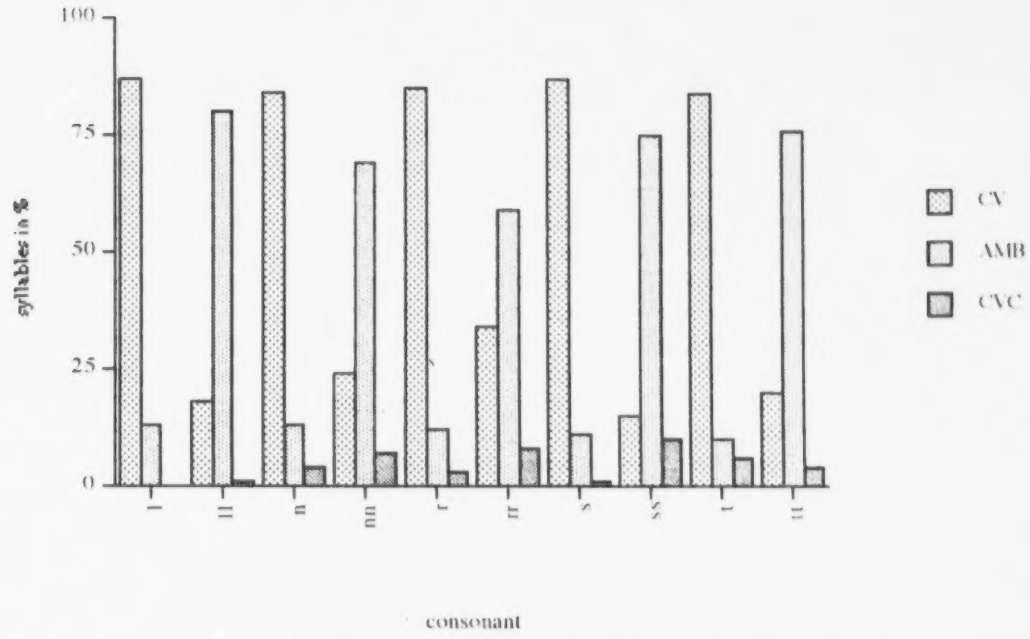

Figure 2-4b: Syllable divisions by letter for French-dominant bilinguals

Discussion

The results clearly show that it is advantageous to employ the visual method because it is simpler to use, faster, and just as accurate as the other two methods. The discrepancy between the ANOVA and the chi-square test is puzzling. However, it is not worrisome because it may be an artifact; the proportions remain highly similar. In any case, a chi-square test seemed more appropriate here, because the data collected were nominal (a choice between three syllable division alternatives). The ANOVA has the advantage of considering the variance, which can be important in small samples such as the one presented here, but it involves a transformation of the data. All in all, the first hypothesis of the present experiment is confirmed, namely, that the results of the three versions of the forced-choice syllabification task are comparable.

Furthermore, it appears that French-dominant bilinguals and English-dominant bilinguals divide syllables of French in different manners, confirming the third hypothesis. French and English-dominants are highly influenced by the number of letters representing intervocalic consonants in the stimuli but in different ways.

French-dominants have clear preferences for CV syllables with singlets and ambisyllabic judgments with doublets. This may have its roots in the way the subjects learned to write and spell; however, because of the span of age among subjects and because alphabetization methods have greatly changed across the last forty years, this possibility is not very likely. The 3% of CVC judgments can probably be considered as error, but the 12% of ambisyllabic judgments is probably too high to be so readily dismissed. A posthoc analysis was performed (Scheffe's S) on the items and on the subjects to test whether certain stimuli would lead to differential results or whether certain subjects would behave differently from other subjects: No pairs even approached significance. A larger sample may have given a clearer picture. This will be tested in the next experiment. The results for French-dominants confirm both aspects of the second hypothesis of the present experiment, that is, that French speakers divide CVCV French stimuli before the intervocalic consonant when the consonant is spelled with a singlet, but differently with doublets.

English-dominants have a clear preference (although lower than that of French-dominants) for CV syllables with singlets but their preferences are less clear with doublets. It is difficult to compare these results with the results obtained by Derwing (1992) in English because of the different choice of factors controlled in his study and in the present one. If one compares the results obtained by Derwing for English stimuli for all consonants with stress on the first syllable and with lax vowels, the results go in the same general direction as the present results for French. The results for singlets seem to be a combined version of Derwing's results for English as L1 and the results obtained for French as L1 in the present experiment. It thus

appears that there is interference by the L1 of the English-dominant subjects on their representation of the French syllable for singlets (see Figure 2-5a). Results for doublets are less clearly a case of interference (see Figure 2-5b). However, there may be a combination of interfering factors that interact to create a complex situation. There is a possibility, for example, that L2 learners studied the syllable division rules in class. Such teaching was favoured by Delattre and is still promoted and used in some modern methods, such as Valdman's in French and Wong's in English. The rules taught may not have differentiated singlets and doublets, resulting in a mixed effect. Another possibility is that the English-dominant subjects who participated in the present research might have syllabified English words differently from Derwing's subjects. This will be tested in the next experiment.

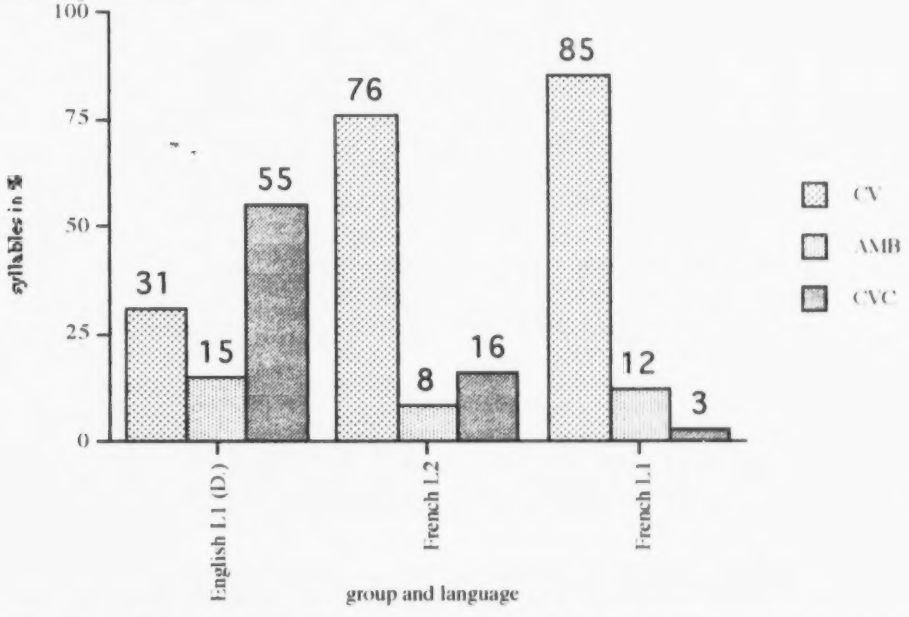

Figure 2-5a: Syllable divisions for English as L1 (Derwing, 1992), French as L2 and French as L1 (present study) for singlets

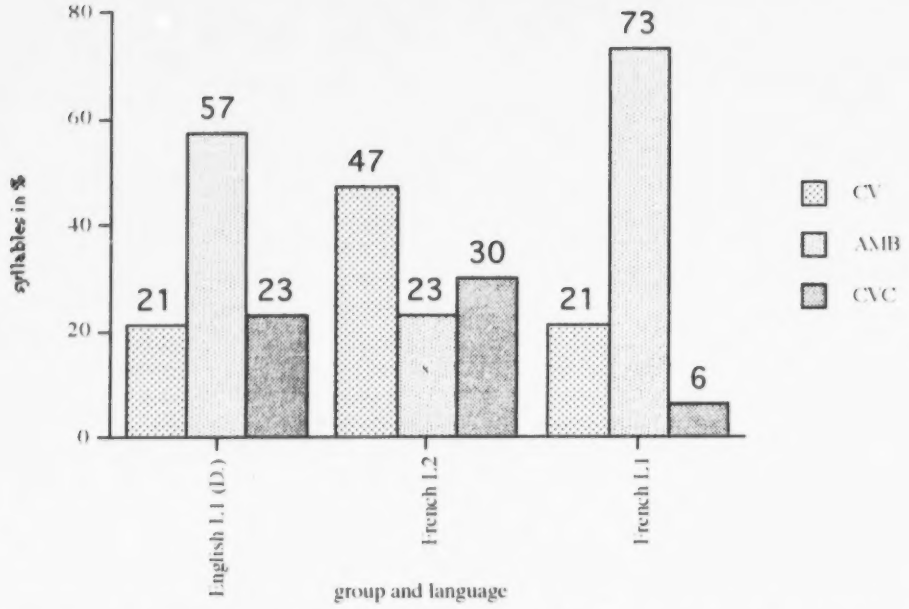

Figure 2-5b: Syllable divisions for English as L1 (Derwing, 1992), French as L2 and French as L1 (present study) for doublets

Summary

The results of the described experiment lead to the conclusion that the pause-break protocol can be modified so as to be more efficient, without compromising accuracy by presenting the syllable division alternative visually instead of aurally. It also shows that syllabification of CVCV French stimuli is highly influenced by the number of letters used to spell the intervocalic consonant, especially for L1 speakers. French speakers generally divide such words before the intervocalic consonant with singlets and give ambisyllabic judgments with doublets. English speakers of French divide their L2 words with singlets in a similar fashion but with a higher proportion of CVC judgments. They divide words with doublets with less distinct preferences.

Future experiments should get a larger corpus and a larger sample of the target population. They should also focus on the ability of L2 learners to adapt their syllable preferences in L2 as a step to language

mastery. Future experiments should also include English stimuli to provide a baseline with which to compare to previous studies. These points will be considered in the design of the experiments presented in the following chapters.

Chapter 3

Syllable structure of French and English as first and second languages*

Introduction

One of the findings of the previous chapter was that French speakers generally divide CVCV words before the intervocalic consonant spelled with single letter (singlet), corroborating the first syllable division rules proposed by Delattre (1940; 1944a; 1944b — chapter one). There was however a 15% deviation from the prediction. Although no linguistic rule applies in 100% of cases and subjects taking part in experiments sometimes make mistakes in giving the answers on a computer screen, a deviation of 15% is probably too high to be attributed to mere error.

This deviation may come from many sources. The first obvious one is that the syllabification rules were set for international French, whereas the subjects who participated in the experiment presented in chapter two were all speakers of Canadian French. A second possible source of deviation is that the rules may have evolved since the time they were set by Delattre in the middle of this century. A third possibility is that the sample size in experiment one was too small to give reliable results. Yet a fourth possibility is that the L1 syllable structure of the French-dominant bilinguals was influenced by the learning of English as L2.

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* This chapter has been published in a modified form in Beaudoin, M. (1995). La perception visuelle et auditive de la coupure syllabique. In L. Godbout (Ed.), Le savoir en tête (73-82). Edmonton: ACFAS-Alberta.

The first possibility is difficult to verify because of the lack of access to speakers of other dialects of French in quantities that would allow an adequate test. The second possibility cannot be verified because no research like the present one was done on French previously. Having older subjects perform the experiment would not be sufficient because, if indeed the representation of the syllable has changed for the general population, theirs likely has as well. The third possibility is easy to verify and to correct. This will be done in experiment two, presented below, where both the number of subjects and stimuli were both greatly increased. The fourth possibility can be checked by including French monolingual and bilingual subjects in the study, which will also be done in experiment two.

In addition to further analyzing the syllabification of the CVCV structure with L2 speakers, a more specific study of L2 syllabification by English speakers will also be done. The results of experiment one showed that L1 and L2 speakers divide bisyllabic words (with singlets) differently from each other. It was concluded that L2 speakers build an interlanguage structure which resembles a blend of the structure of L1 and the structure of L2 (see Figure 2-5a, chapter two). This suggests that L2 syllable structure can be learned.

In chapter two, The question was raised as to whether the English-speaking subjects who participated in experiment one were representative of English subjects in general. To answer this question, the number of subjects was increased, a list of English stimuli was used in addition to the French stimuli (in separate segments of the experiment), and English monolinguals also participated to verify whether the results obtained were truly comparable to those obtained in previous studies in English. The English stimuli used resembled the French stimuli as closely as possible to allow internal comparison, and they in turn were compared to the stimuli that resemble them the most in Derwing (1992).

One last point that arises from the results of experiment one is that English-French bilingual subjects who have reached equal proficiency in both languages (balanced bilinguals) may display the syllable structure of L1 speakers in each language, whether they learned both languages simultaneously or consecutively. It would be interesting to verify if late balanced bilinguals achieve such results because it would mean that L2 syllable structure can be acquired. However, balanced bilinguals are rare and it was not possible to reach enough of each kind of subject to test this thoroughly.

To summarize the predictions based on the studies reviewed, here are the four conflated hypotheses that will be tested in experiment two:

H-d. French monolinguals divide CVCV stimuli before the intervocalic consonant when the consonant is spelled with a single letter.

H-e. English speakers of French as L2 divide CVCV stimuli in a way different from L1 speakers. The difference should go in the direction of the syllabification of English.

H-f. English monolinguals should divide English stimuli in a way that is compatible with previous studies (Derwing, 1992, among others).

H-g. Balanced bilinguals divide English stimuli as English monolinguals do and French stimuli as French monolinguals do.

Methodology

Subjects

Forty-eight subjects participated in the present study. None of them had participated in the experiment presented in chapter one. The average age of the subjects was 22.5 years (σ = 5.88; min.: 18, max.: 40). There were 27 men and 21 women. Nine identified themselves as French monolinguals and nine identified themselves as English

monolinguals. The others said they were bilinguals. A bilingual person is defined here as a person who speaks French and English at a functional level and has limited knowledge of any other language. The evaluation of the subjects' dominance for either of the two languages was done by a general self-evaluation on a scale from 1 to 7, 1 meaning nil and 7 meaning perfect. The value obtained for the self-evaluation of English was subtracted from the value obtained for French to provide the French-differential score. Based on this score, 12 were English-dominant bilinguals, 14 were French-dominant bilinguals, and 4 were balanced bilinguals. Table 3-1 gives the averages of the self-evaluation scores for each language. Subjects were registered in a post-secondary institution, either the University of Alberta (Edmonton — for most subjects) or the CEGEP de Matane (Québec — for French monolinguals). All subjects were native speakers of Canadian English or Canadian French. None of the subjects had received any corrective phonetic training.

Table 3-1: Means and standard-deviations for the self-evaluation (maximums score is 7) and the French-differential scores:

Group	French	English	F.-D. score
French monolinguals ($n = 9$)	6.1 ($\sigma = 0.47$)	2.2 ($\sigma = 1.73$)	3.9
French dom. bilinguals ($n = 14$)	6.2 ($\sigma = 0.66$)	4.6 ($\sigma = 0.71$)	1.6
Balanced bilinguals ($n = 4$)	5.9 ($\sigma = 0.71$)	5.9 ($\sigma = 0.71$)	0
English dom. bilinguals ($n = 12$)	4.6 ($\sigma = 0.87$)	6.8 ($\sigma = 0.43$)	-2.2
English monolinguals ($n = 9$)	2 ($\sigma = 0.67$)	6.4 ($\sigma = 0.69$)	-4.4

Material

A list of CVCV French and English words was constructed as follows: The first consonant and the second vowel were not controlled, notwithstanding the fact that the words had to be spelled with 4 letters. The second consonant was one of the following: /t/ (realized as a

dental flap for most English stimuli), /f/, /v/, /m/, /n/, /l/, /R/ (or /ɹ/ for English stimuli). This was done in order to have consonants of all types (except for glides, which rarely occur as the single intervocalic consonant of CVCV French words). The consonants thus included stops, voiced and voiceless fricatives, nasals, /l/, and some /R/ (or /ɹ/ for English stimuli). The first vowel was always non-nasal. All words respecting this structure were extracted from the *Robert Électronique* and the *Oxford English Dictionary* (electronic version). Fewer English words than French words with such a structure were found. Also, no words involving /m/ as the intervocalic consonant were found in French. To ensure that all the words were well known, they were checked by 5 bilingual university students who came from the same population as the core group of subjects who performed the experiment, but did not participate in the experiment to be described in the present chapter. The final list contained 136 CVCV stimuli, 40 English words and 96 French words. All but two of the English words were stressed on the first syllable.

Table 3-2: List of stimuli for experiment two

English words

/t/ beta, data, duty, loto, veto
/f/ defy, sofa, tofu
/v/ lava, levy, navy, wavy
/m/ coma, demo, mama, memo, puma, semi, sumo
/n/ bony, deny, many, pony, puny, zany
/l/ cola, deli, gala, halo, holy, polo, rely, solo
/ɹ/ bury, fury, gory, hero, jury, vary, zero

French words

/t/ cota, côté, data, daté, dota, doté, fêta, fêté, futé, gâta, gâté, loto, pâté, rata, raté, rôti, tâta, tâté, têtu, véto, vêtu, vota, voté
/f/ café, défi, sofa
/v/ bava, bavé, cuva, cuvé, gava, gavé, java, lava, lavé, pava, pavé, ravi, rêva, rêvé, sévi
/n/ fana, fané, gêna, gêné, pané, puni, zona, zoné

/l/ calé, cola, fêla, fêlé, gala, mêla, mêlé, pâli, poli, polo, râla, râlé, sala, salé, sali, solo, télé, valu, vélo, vola, volé, zélé

/R/ curé, dora, doré, dura, duré, féru, fora, foré, gara, garé, géra, géré, jura, juré, jury, mari, muré, mûri, para, paré, pari, paru, péri, tari, zéro

The French stimuli were recorded individually in a random order by a French-speaking male announcer at Radio-Canada (Edmonton) who was from Ontario. The English stimuli were recorded individually in a random order by an English-speaking male professor of English working at the University of Alberta, who was also from Ontario. The recording was done in a soundproof room on a Tandberg TCR 522 tape recorder with an omnidirectional Sony ECM 50 microphone on a TDK-SA cassette. The stimuli were digitized at 11Khz with SoundEdit using a MacRecorder digitizer with no additional filters. Care was taken to leave less than 1 ms of silence at the beginning of the digitized stimuli.

The experiment was carried out on a Macintosh SE with a Hypercard stack especially designed for the study. The subjects listened to the stimuli through Sony DR-7 headphones set on monophonic binaural mode. Each subject was tested individually in a quiet room.

Procedure

All of the interactions between the subjects and the researcher were in French, except in the case of the English monolinguals. After reading the instructions (see appendix) and putting on the headphones, the subjects were requested to enter personal information on the computer (age, sex, general proficiency in French, and general proficiency in English). Then the experiment started. The subjects' task was to choose the division that best fit the way they would divide the target word that was heard.

The list for each language was tested separately and the order in which the language appeared was randomized. The experiment was organized as follows: Additional instructions specific to each language were presented first, an example chosen at random was taken from the list, more instructions were given in order to make sure that the subject was ready to start, then the presentation of the experimental list began. For each item, the target word was played at the same time as the syllable divisions were shown in three boxes placed in the center of the screen. There was a one-second break between stimuli. The order of word presentation and the order of syllable division alternatives were randomized for each subject.

Results

The dependent variable under study was the choice of syllable division alternatives preferred by each subject for each stimulus in each group. There was a significant difference between groups of speakers of French as L1 and L2 but not in English (for French stimuli: $F(4, 4524) = 33.333$, $p = .0001$; for English: $F(4, 1857) = 1.599$, $p = .1720$ — see Table 3-3). This means that all groups divided the English words in a comparable fashion, although some of the groups divided the French words differently, as shown in Figures 3-1a and 3-1b. In particular, French monolinguals, French-dominant bilinguals and balanced bilinguals divided French stimuli in essentially the same way; however, they divided them differently from the way English monolinguals and English-dominant bilinguals did. English-dominant bilinguals tended to divide French stimuli in a manner that fell between that of English monolinguals and French speakers (see Figure 3-1b).

Table 3-3: Result of a Scheffe's S done on the status for syllable preferences on French stimuli (significance level: .05 = "S")

	vs.	diff.	crit. diff.	p-value	sign.
Fr. mono.	Bal.	.010	.138	.9997	
	Fr. dom.	.079	.099	.1924	
	En. dom.	.242	.102	.0001	S
	En. mono.	.331	.108	.0001	S
Bal.	Fr. dom.	.069	.131	.6236	
	En. dom.	.231	.133	.0001	S
	En. mono.	.320	.138	.0001	S
Fr. dom.	En. dom.	.163	.091	.0001	S
	En. mono.	.252	.099	.0001	S
En. dom.	En. mono.	.089	.102	.1218	

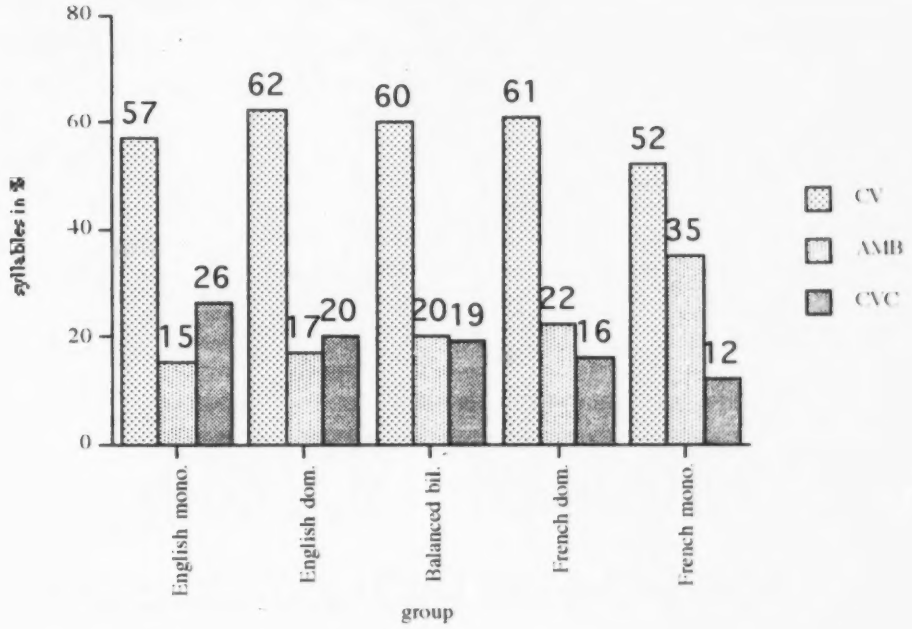


Figure 3-1a: Syllable divisions for English stimuli by subject group

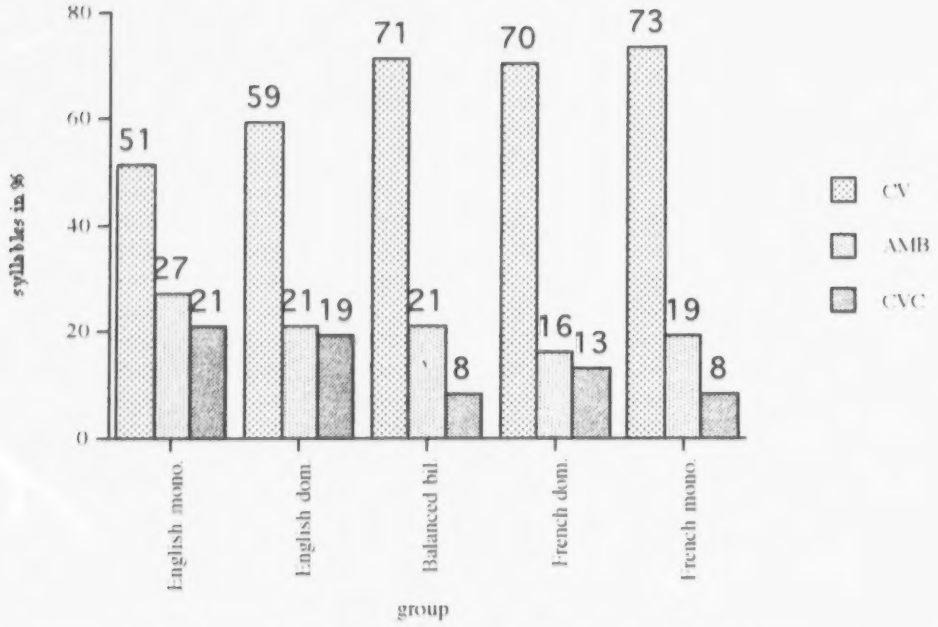


Figure 3-1b: Syllable divisions for French stimuli by subject group

Results for French monolinguals, French-dominant bilinguals and balanced bilinguals were consistent with the results of French-dominant bilinguals obtained in the first experiment (for French stimuli), although with fewer CV judgments and more CVC and ambisyllabic judgments. These differences may be due to differences in the phonemic structure of the items. No significant differences were found accross the five manner of articulation types in French (except for the English monolinguals who also showed such differences in English, a point that will be discussed later). The vowel effect for the vowel preceding the intervocalic consonant (V1) reached significance for French-dominant bilinguals and balanced bilinguals ($F(6, 1300) = 7.005$, $p = .0001$, and $F(6, 371) = 8.757$, $p = .0001$ respectively). See Tables 3-4a and 3-4b. For balanced bilinguals, the vowel /ɛ/ that led to more CVC judgments (33%) and more ambisyllabic judgments (24%) than other vowels and the /ɑ/ led to a slightly higher proportion of ambisyllabic judgments (19%) but still

lower than for /ɛ/. For French-dominant bilinguals, the vowels /e/ and /o/ also led to a higher proportion of CV syllables (89% and 82% respectively). These results are not surprizing since /e/ and /o/ are hardly ever found in CVC syllables. Since this factor did not reach significance for other groups of subjects, and since the effect is only marked for balanced bilinguals, this issue will not be pursued further. To test the potential influence of a factor briefly mentioned in chapter one, an ANOVA was done on the voicing difference between /f/ and /v/; no significance was found ($F(1, 159) = 1.096$, $p = .2968$). However, since the number of such stimuli in the list was very limited, nothing should be made of this finding without further investigation.

Table 3-4a: Result of a Scheffe's S done on the vowels for syllable preferences on French stimuli by French-dominant bilinguals (significant values only)

	vs.	diff.	crit. diff.	p-value	sign.
/e/	/a/	.258	.238	.0220	S
	/y/	.293	.284	.0379	S
	/ɔ/	.371	.270	.0006	S
	/ɛ/	.390	.284	.0006	S
/o/	/ɔ/	.345	.331	.0337	S
	/ɛ/	.364	.343	.0279	S

Table 3-4b: Result of a Scheffe's S done on the vowels for syllable preferences on French stimuli by balanced bilinguals (significant values only)

	vs.	diff.	crit. diff.	p-value	sign.
/ɑ/	/e/	.511	.490	.0334	S
/ɛ/	/e/	.735	.441	.0001	S
	/o/	.674	.531	.0027	S
	/a/	.560	.358	.0001	S
	/y/	.429	.429	.0494	S

The manner of articulation of consonants in the English stimuli influenced the syllabification of English monolinguals and English-dominant bilinguals ($F(4, 346) = 12.666$, $p = .0001$ and

$F(4, 460) = 7.592$, $p = .0001$ respectively). However, a closer look at these data reveals that all manners of articulation were treated the same except for /ɹ/, as indicated by Scheffe's Ss (see Table 3-5 and Figure 3-2). The /ɹ/ leads to a much higher proportion of ambisyllabic judgments than other consonants. Manner of articulation is not a significant factor for balanced bilinguals in English ($F(4, 150) = 1.922$, $p = .1096$).

Table 3-5: Result of a Scheffe's S done on the manner of articulation for syllable preferences on English stimuli by English monolinguals (significant values only)

	vs.	diff.	crit. diff.	p-value	sign.
/l/	/ɹ/	.925	.439	.0001	S
fricatives	/ɹ/	.828	.455	.0001	S
stops	/ɹ/	.756	.506	.0003	S
nasals	/ɹ/	.652	.400	.0001	S

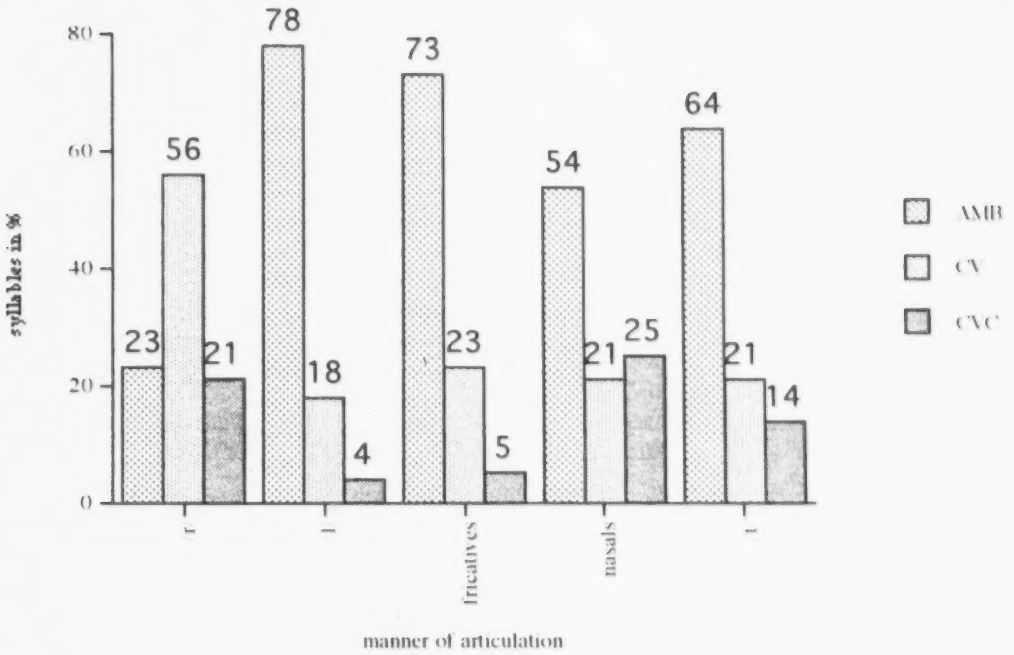


Figure 3-2: Syllable divisions for English stimuli by manner of articulation of intervocalic consonants for English monolinguals

The tenseness of both vowels of the English stimuli seems to be an important factor for English monolinguals and English-dominant bilinguals. The tenseness of the vowel preceding the intervocalic consonant (V1) is a significant factor for English monolinguals ($F(1, 314) = 25.298$, $p = .0001$) and for English-dominant bilinguals ($F(1, 406) = 26.521$, $p = .0001$). The tenseness of the vowel following the intervocalic consonant (V2) is also a significant factor for English monolinguals ($F(1, 323) = 8.062$, $p = .0048$) and for English-dominant bilinguals ($F(1, 429) = 5.976$, $p = .0149$). V1 tenseness is a significant factor for French-dominant bilinguals ($F(1, 474) = 16.469$, $p = .0001$) but V2 tenseness is not ($F(1, 501) = 1.447$, $p = .2295$). Finally, V2 tenseness is significant for balanced bilinguals ($F(1, 141) = 5.673$, $p = .0186$) but V1 tenseness is not ($F(1, 98) = 1.283$, $p = .2601$). Neither of the vowels are significant factors for French monolinguals (V1: $F(1, 302) = 1.002$, $p = .3176$); V2: $F(1, 322) = 1.010$, $p = .3157$).

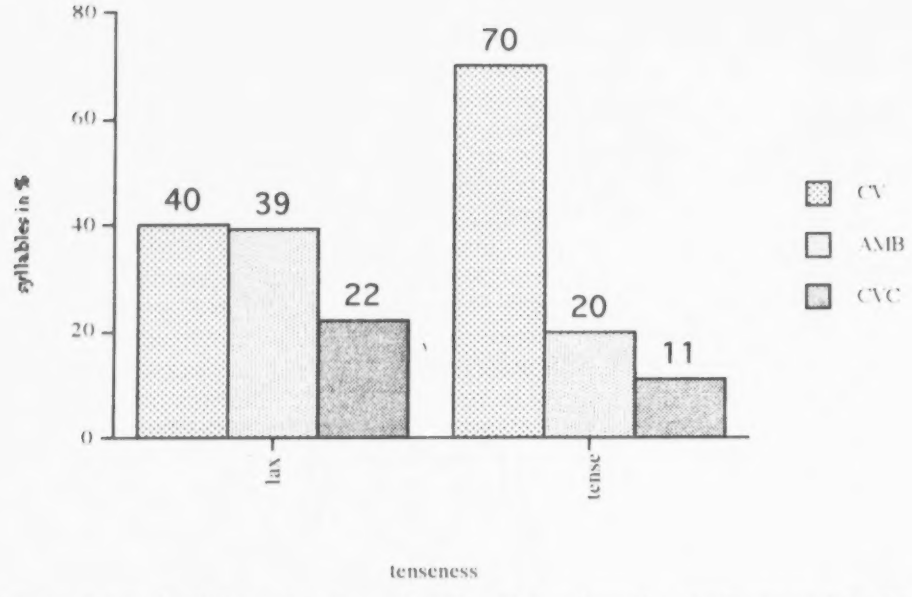


Figure 3-3a: Syllable divisions for English stimuli as influenced by V1 tenseness for English monolinguals

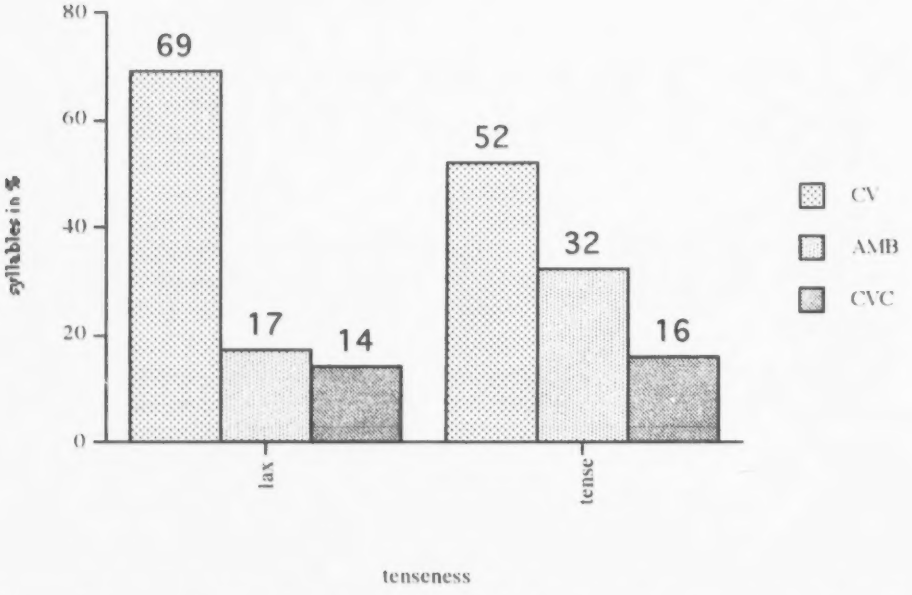


Figure 3-3b: Syllable divisions for English stimuli as influenced by V2 tenseness for English monolinguals

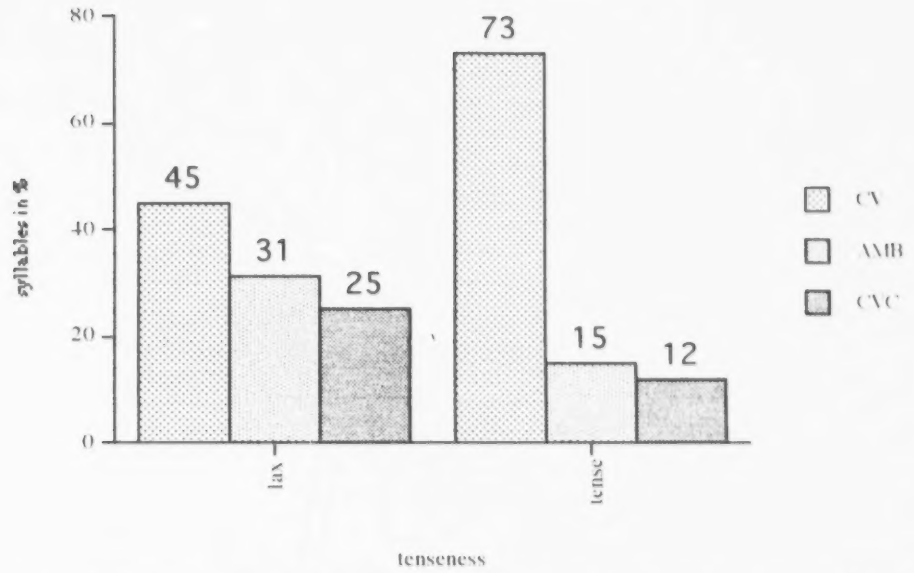


Figure 3-3c: Syllable divisions for English stimuli as influenced by V1 tenseness for English-dominant bilinguals

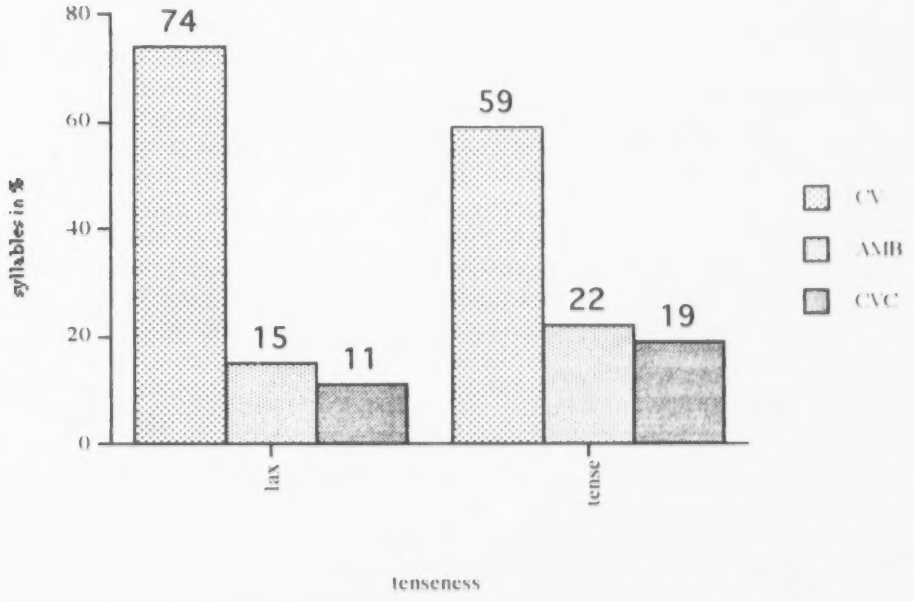


Figure 3-3d: Syllable divisions for English stimuli as influenced by V2 tenseness for English-dominant bilinguals

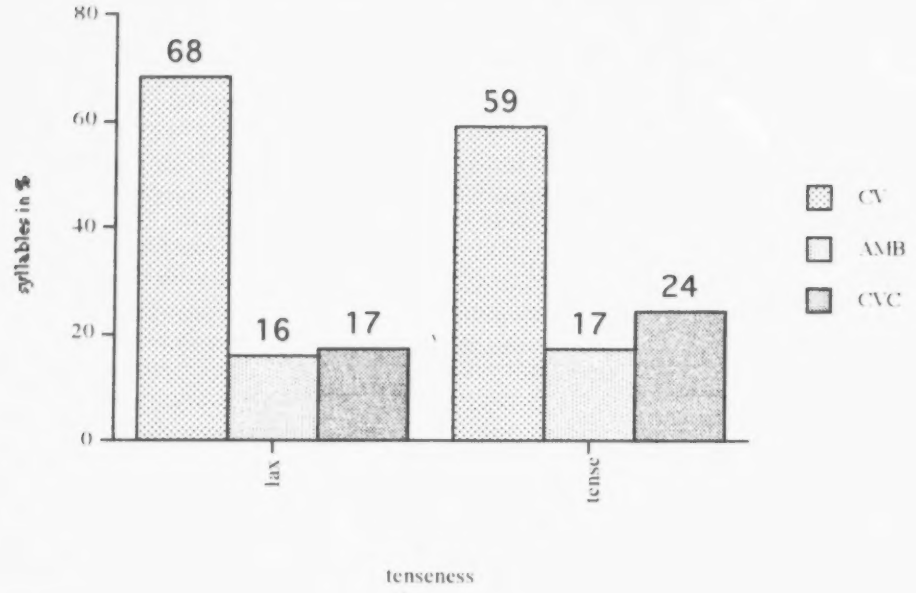


Figure 3-3e: Syllable divisions for English stimuli as influenced by V1 tenseness for French-dominant bilinguals

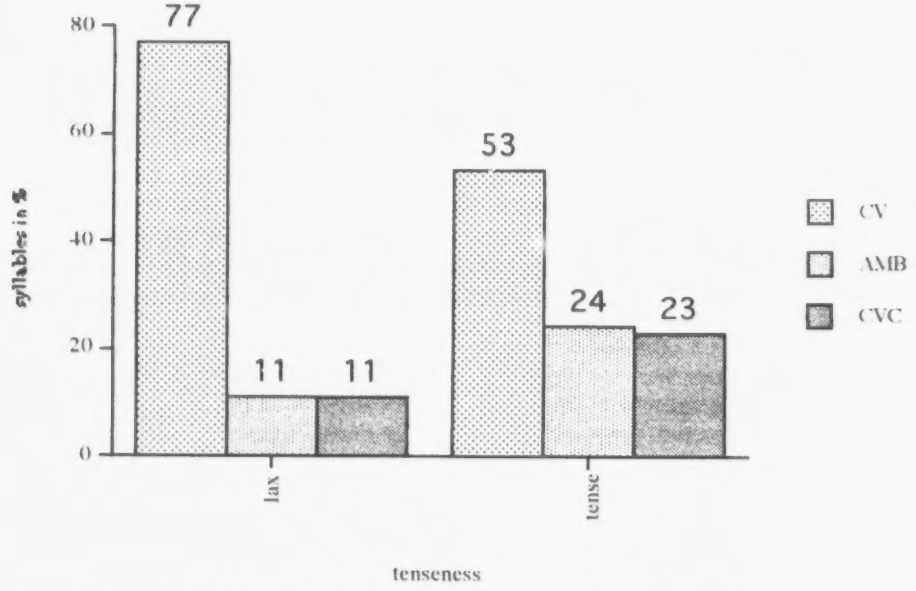


Figure 3-3f: Syllable divisions for English stimuli as influenced by V2 tenseness for balanced bilinguals

As can be seen in Figures 3-3a to 3-3f, V1 and V2 tenseness play a role in the syllabification of English stimuli. This is clear and regular for English-dominant bilinguals and English monolinguals, and with V2 tenseness only for balanced bilinguals. However, the trends of V1 tenseness for French-dominant bilinguals go in the opposite direction from that of English-dominant bilinguals and English monolinguals: CV judgments are predominant both for lax and for tense V1 but even more so for lax than for tense V1.

When compared to the results obtained by Derwing (1992), averaging across all stimuli with stress on the first syllable and with single letter spellings, the present results with V1 in English stimuli for English monolinguals go in the same directions for tense vowels. However, in the present results, lax V1 do not predominantly lead to CVC judgments as in the case for Derwing's subjects (22% here, instead of 55% in Derwing, 1992). This could be caused by the size of the English list used here. Because the lax V1 effect is variable depending on the following consonant, the proportion of different consonants may also have had some influence on the overall results.

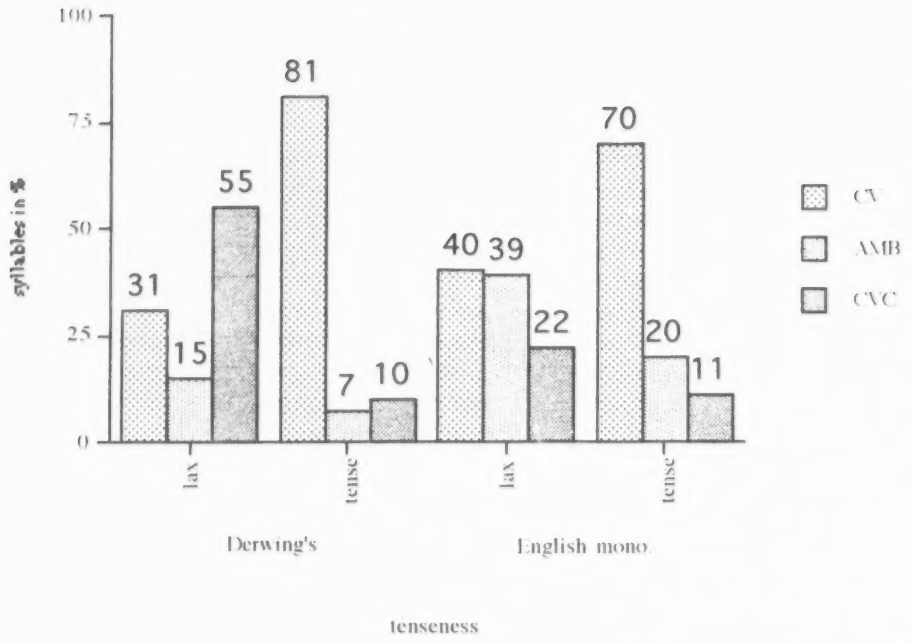


Figure 3-4: Syllable divisions for English stimuli as L1 for Derwing (1992) and English monolinguals by V1 tenseness

Discussion

The primary objective of the present experiment was to confirm the results obtained in chapter two on CVCV syllabification by French L1 speakers, using a wider range of stimuli. In chapter two, it was found that French L1 subjects generally divided such stimuli as two open syllables when they were spelled with one singlet as the intervocalic consonant. The present results generally confirmed these findings, although ther was more variation in experiment two than in experiment one. It was nonetheless true that French monolingual subjects syllabified CVCV French stimuli as two CV judgments in about 73% of the cases, leaving only about 19% of ambisyllabic judgments and 8% of CVC judgments (see Figure 3-1b). French-dominant bilinguals and balanced bilinguals gave very similar results. The variation observed is probably too large to attribute to mere error,

however, and other factors not measured here were undoubtedly involved. One of these factors could be linked to subject variables such as the place of birth and dialect spoken, age of acquisition of L2, etc. The experiment presented in the next chapter will offer better control of these variables.

The phonemic composition of the stimuli seems not to be an important factor for syllabification in French as L1. The manner of articulation of the intervocalic consonant did not show any significant effect with French stimuli.

One of the important findings of the present experiment is that L1 and L2 speakers clearly divide their syllables differently. Furthermore, the divisions favoured by L2 speakers of French are placed at what appears to be a middle point between English and French syllabification, a pattern predicted by contrastive analysis. Even more interesting is the fact that L2 speakers exhibit patterns of syllabification in their L2 that differ from what they do in L1: English-dominant bilinguals are influenced by the phonemic composition for English stimuli but not for French stimuli, whereas English monolinguals are influenced in both cases. English-dominant bilinguals may be using two concurrent phonological systems, one in which the phonemic composition is a determining factor for syllabification and the other in which it is not. This implies that these subjects would have a way of functioning in one system at a given time (for a discussion of the possible representation of such systems, see Beaudoin, 1991).

As expected, English monolinguals syllabify French stimuli in the same way they syllabify English stimuli. However, L1 speakers of French syllabify English words in a way that is comparable to that of English L1 speakers. This may be explained by the fact that French L1 speakers are more knowledgeable of English than English L1 speakers are of French, as indicated by the self-evaluation scores presented in Table 3-1. French Canadians (even monolinguals living in Québec) are

highly exposed to English culture through music, films, books, etc., whereas English Canadians are not similarly exposed to French culture. Another possibility here is that the number of English stimuli used may not have been large enough to lead to significant differences.

English speakers were influenced in their syllable preferences in a way similar to that of Derwing's subjects (1992). Although it is difficult to compare the results for the two studies because of diferences in both the stimuli and the application of the protocols, the same general effects were nonetheless found to be significant. Both the manner of articulation of the intervocalic consonant and the tenseness of the vowel preceding it (V1) were important factors in both studies. In addition to that, the tenseness of the vowel following the intervocalic consonant (V2) was found to be significant here. As can be seen on Figure 3-5, what seemed to happen here was that the intervocalic consonant was treated as ambisyllabic if V1 was lax and V2 was tense (written as L/T in Figure 3-5). Also, as a general rule, the consonant was syllabified as the onset of the second syllable if V1 was tense, but not if both vowels were lax, in which case the consonant is the onset of the second syllable because stress was predominantly on the initial syllable in the items of the English list. If the intervocalic consonant was /ɹ/, the chances of ending up with an ambisyllabic judgment were even greater.

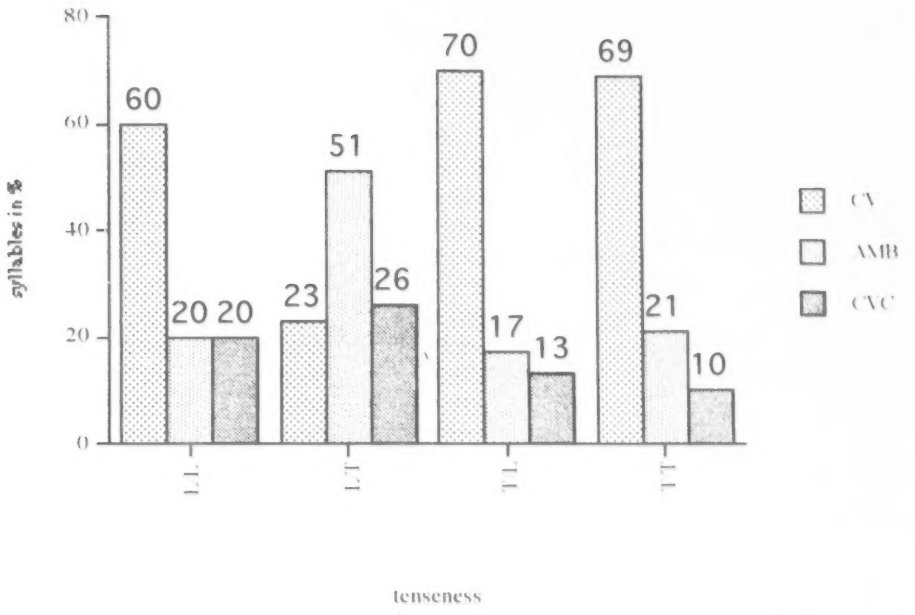


Figure 3-5: Syllable divisions for English stimuli as influenced by V1 and V2 tenseness and their order for English monolinguals

One final finding of the present experiment was that balanced bilinguals gave similar general patterns of results to those of monolinguals of either language. However, as shown in the result section (pp. 68-73), they did not generally use phonemic components (vowel tenseness and manner of articulation of consonants) to syllabify English stimuli as English L1 speakers did. One possible explanation is that the so-called balanced bilinguals of this experiment might have wrongly evaluated their relative performance in French and English. Better control of the self-evaluation will be assured in the next experiment.

Summary

To summarize the findings of the present experiment, French CVCV strings are generally syllabified as two open syllables by French L1 speakers as predicted by Delattre (1940; 1944a; 1944b). L2

speakers, however, do not syllabify the same way as L1 speakers in French, even though English-dominant bilinguals do syllabify English stimuli in a way similar to English monolinguals in the present experiment and relevant parts of Derwing's experiment (1992). More specifically, English L1 speakers are affected by the manner of articulation of the intervocalic consonant and by V1 and V2 tenseness in their syllabification of English stimuli. French L1 and L2 speakers did not use such phonemic information to syllabify French. Overall, L2 speakers of French syllabify French stimuli as if their representation of the French syllable were a mixed structure of their L1 and the target L2. This supports a contrastive analysis of the syllable structure in L2 learning situations.

Although the results obtained in the present experiment were rather clear, some aspects of the design were faulty. First, more information on the subjects could help in the interpretation of some of the results. Second, more precision on the self-evaluation might be important to discriminate between balanced and dominant bilinguals. In such a case, a measure of the language group with which the subjects identify should also be noted following the suggestion of Cutler et al. (1992). Third and last, because the patterns of results are similar to those obtained in the previous experiment and because they do follow the predictions made from theoretical work on the French syllable, other syllable structures should also be studied to give a broader view of French structures.

Chapter 4

Specific syllable structures of French

Introduction

In the previous chapters, perceptual experiments revealed that French bisyllabic words involving single intervocalic consonants were divided by French speakers before the intervocalic consonant. This result is not surprising in that it corroborates findings by other researchers using other methodologies. This chapter will extend perceptual experimentation to other syllable structures of French. A brief review of the literature on syllable structures of French will first be presented to allow hypotheses to be formulated. Then the experimental methods will be described and an analysis of the results will be presented. The results will be discussed in regard to the current knowledge of French syllable structure.

As detailed in chapter one, Delattre (1940) proposed a series of pedagogical rules to facilitate the teaching of French pronunciation. His rules were developed on an intuitive basis without any experimentation reported. Although there is a risk involved in equating theoretical structures to intuitive impressions of syllable division (Lowenstramm, 1981), some of Delattre's rules were corroborated by experiments performed later by other researchers, as will be seen below.

The first rule put forth by Delattre was that polysyllabic words involving single intervocalic consonants should be divided before the intervocalic consonant. This rule was corroborated by Kolinsky, Morais, & Cluytens (1995), Marouby-Terriou & Denhière (1994) and by the experiments presented in the previous chapters of this thesis,

using different methodologies. Kolinsky et al. (1995) performed a dichotic listening experiment, where subjects hear a portion of a bisyllabic word in one ear and the other portion of that word in the other ear. They found that "illusory target words are more frequently experienced when the distribution corresponds to syllables than when it corresponds to either the initial consonant (and its phonetic feature) or the first vowel." (p. 19).

The second rule developed by Delattre was based on sonority scales. He theorizes that the sonority of the components of a syllable should rise toward the nucleus and fall following it. Thus, if a consonant cluster precedes the nucleus, the first consonant should have a lower sonority than the second consonant of the cluster, which should also be lower than the sonority of the third consonant, if there is one. The sonority scale used by Delattre (1944a; 1944b) goes as follows (from the lowest to the highest sonority):

stops ⇒ nasals ⇒ fricatives ⇒ liquids ⇒ glides

This sonority scale had been developed by de Saussure and similar scales have since been used in recent phonetic works, although with slight variations (e.g. Derwing & Nearey, 1991; Zec, 1994).

Dell (1995) presents another theoretical analysis of consonant clusters in French. His analysis is based on the acceptable word-initial and word-final clusters. Specifically, he assumed that a consonant cluster found word-initially would also be allowed syllable-initially, and a cluster found word-finally would also be allowed syllable-finally (see also Pulgram, 1970). The basic rule was that "a coda contains at most one consonant" (p. 16). Dell also considered a obstruent + liquid sequence as a single consonant, except clusters in which both consonants were coronals or clusters in which the first one was a coronal fricative (e.g., "patelin", "passerelle"). Although there were other aspects of Dell's hypothesis that will be overlooked here, the application of his rule leads to results similar to those of Delattre.

Indeed, words such as "bourgeois", "portrait", and "risquer" all seem to respect the rules of both researchers.

The present chapter will test experimentally the syllable division that is preferred by French speakers for some of the consonant clusters that were just discussed. Specifically, it will deal with stimuli with the following structure: CVCV, CVPPrV, CVPrV, CVsPV, where C is any consonant, V is any vowel, P is a plosive (stop), r is /R/, and s is /s/.

The first two structures are used as a control to ensure that the protocol is valid and to provide results that are consistent with previous experiments and established syllable divisions. In that respect, the first structure (CVCV) is predicted to be divided between the first vowel and the intervocalic consonant by French speaking subjects, corroborating Kolinsky et al. (1995), Marouby-Terriou & Denhière (1994) and the research described in previous chapters. The second structure (CVPPrV) is predicted to be divided between the stops. This prediction comes from both Dell (1995) and Delattre (1944a; 1944b). Other divisions are very unlikely for this structure. The third structure (CVPrV) is predicted to be divided before the stop. This prediction comes from Dell (1995), where an obstruent + /R/ cluster is even considered as a unit, and from Delattre (1944a; 1944b). The last structure (CVsPV) is expected to be divided between the /s/ and the stop. This prediction comes from Dell (1995) and Delattre (1944a; 1944b). However, some variation is to be expected. This rule reflects the fact that this sequence was not allowed in Old French word-initially and was therefore split in intervocalic position, leaving the /s/ as the coda of one syllable and P as the onset of the next one. Because of loan-words starting with this cluster, however, it is possible that French has undergone a change toward not always splitting it in intervocalic position, since it has been accepted word-initially for at least five centuries in a few items. French speakers are most likely not aware of the historical origins of the rule. Delattre and Dell, however, both support the idea that this rule still generally applies. This cluster may thus be split most of the time, but variation reflecting the

historical change is expected. The extent of the variation is not predictable.

In addition to the primary effect of word structure, factors related to the segmental composition of the stimuli (manner of articulation of the medial consonant and the quality of the first vowel) may have influenced the results to be described. The effect of these factors was measured in the other experiments presented in the previous chapters of this thesis and no effect was found for French stimuli. Therefore, the stimuli in the present experiment did not control such factors. Furthermore, because of the word structures used here and the restrictions imposed by phonetic structure, the frequency of the words was not controlled either. Two subjects reported that they had heard some of the words before but would not use them themselves. Nobody reported not knowing a specific word, although no systematic attempts to elicit such reports were carried out.

To summarize the predictions based on the studies reviewed, here are the four hypotheses that will be tested in experiment three:

H-h. French speakers divide CVCV stimuli before the intervocalic consonant when the consonant is spelled with a singlet (a control part of the experiment).

H-i. CVPPrV stimuli are to be divided between the two stops (another control, since other divisions would be an aberration).

H-j. CVPrV stimuli are to be divided before the 'Pr' cluster, a cluster considered strong.

H-k. CVsPV stimuli are mainly to be divided between /s/ and the stop, with some variation is to be expected.

Methodology

The experiment presented here involves a subset of subjects that participated in a larger experiment. The original sample included

French-dominant bilinguals, English-dominant bilinguals, and multilinguals. The multilingual subjects were not considered here because of the potential contamination of their syllable divisions by languages other than English and French; these subjects initially judged themselves as "bilinguals" and revised their label as specific information gathered on L3 was asked. They nonetheless participated in the research but their data were set aside for later analysis. The English-dominant bilinguals were all fluent in French and could have been studied here, but the goal of the present chapter was not to study L2 representation. A cursory analysis of their data shows that their syllable preferences for French were generally comparable to those of French-dominant bilinguals, but they were not included int the main analysis reported here.

Subjects

Fifteen French-dominant bilingual subjects participated in the present study. None of them had participated in the experiments presented in chapters 2 or 3 . The average age of the subjects was 22.8 years (σ = 5.64; min.: 19, max.: 41). There were 7 men and 8 women. All of them identified their L1 as French and spoke English to some degree, and none of them spoke any other languages. They had started to study English at an average age of 12.93 years (σ = 5.26; min.: 5, max.: 20). All of them were studying at the French faculty of the University of Alberta (Faculté Saint-Jean), taking all or most of their courses in French. Among the 15 subjects, 10 were born in Québec, 4 in Alberta and 1 in Saskatchewan.

The language dominance of the subjects was this time assessed using two separate tests. The first one was a self-evaluation specific to oral comprehension, written comprehension, oral production, and written production, both for French and for English. The self-evaluation was marked on a scale of 1 to 7, 1 meaning "no functional knowledge of this language" and 7 meaning "native-speaker like in this language". The results from the four tests of each language were added to get a general self-evaluation score (with a maximum score of

28 — see Table 4-1). A colour-naming task (Hamer & Blanc, 1989; Beaudoin, 1991) was also used in the determination of their language dominance. This test consisted of a piece of paper where 50 dots of 4 colours (black, green, blue and red), placed at random on 10 lines of 5 dots. The subject had to name the colours in the order presented as fast as possible and to reread any misread dot . Different versions of the same page were used for each language, and they each contain approximately equal numbers of dots of each colour. The timing was recorded with a stopwatch and counted in seconds. The test was always done in French first, since the rest of the procedures were carried out in French. One subject could not perform the colour-naming task because his vision was achromatic.

Table 4-1: Means and standard deviations for the self-evaluation scores (maximum score is 28):

In French:	27.6 $\sigma = 0.88$; min.: 25, max.: 28
In English:	22.26 $\sigma = 3.63$; min.: 17, max.: 28
French minus English:	5.33 $\sigma = 3.88$; min.: 0, max.: 11

The results of the colour-naming task for French were subtracted from the results for English because only the difference between the two was relevant. A big difference means a strong dominance and no difference means no dominance. Just as an indication, it took an average of 27.43 seconds ($\sigma = 5.32$) to name all the colours in French, and an average of 34.14 seconds ($\sigma = 6.83$) in English. The average difference for the group was 6.71 seconds ($\sigma = 3.35$; min.: 1, max.: 12). The group appeared quite comfortable in French (of course) and a little less so in English. Two subjects had no dominance according to the self-evaluation test but had a slight dominance in the colour-naming task. The combination of both tests seems valuable and takes less than 5 minutes. A Pearson correlation coefficient test revealed that there was a strong relationship between the results of the two tests ($r = .599, p > .05$ — Bhushan, 1978).

Material

Four lists of stimulus words (see list below) were constructed so as to respect some common rules. All of the words were extracted from the *Robert Électronique* with the following constraints: The first consonant and the second vowel were not controlled; the first vowel could not be spelled with more than one letter (therefore no nasals); the final letter of the words could not be an "e" because some subjects could have pronounced it as a schwa, which would have affected the syllabification (a final schwa is not normally pronounced in Canadian-French [Walker, 1984], but overcorrection could have occured because of the nature of the task); twelve stimuli had a final consonant, although most did not; all stimuli were bisyllabic.

CVCV : Forty stimuli were taken at random from the list described in chapter 2 of the present thesis. They were used as a mean to collect more data on this structure (one of the most frequent ones in French) and to allow comparison with the experiments presented in the two previous chapters. They were all spelled with a singlet, based on the results obtained in the first chapter (where doublets were syllabified as CVC.CV whereas singlets were syllabified as CV.CV). Based on previous experiments, subjects were expected to divide these stimuli as two CV groups in about 75% of the cases (open syllables). The remaining 25% of the cases were expected to be divided either as ambisyllabic or as CVC syllables (closed syllables).

CVPPrV : Only two bisyllabic stimuli involving intervocalic 'PPr' clusters respecting the common rules were found in the *Robert Électronique*. These words, "spectral" and "spectraux", were thus used as a way of verifying the experimental protocol. Indeed, because of the two contiguous stops, syllable divisions other than between these two consonants is very unlikely.

CVPrV : Forty words involving the cluster 'Pr' in intervocalic position were extracted from the dictionary. Clusters were either /pR/, /tR/ or /kR/. If, as suggessted by Dell (1995), these clusters function as a

single consonant, it is to be expected that the cluster will not be split; a syllable division should always either precede or follow the cluster.

CVsPV : Forty words involving the cluster 'sP' in intervocalic position were extracted. This structure is predicted to be split because of the sonority of its components and because of Dell's single-consonant coda rule. This structure was not allowed in Old French word-initially and was therefore split in the intervocalic position, leaving the /s/ as the coda of one syllable and C as the onset of the next one. As previously noted, because of loan-words starting with this cluster, this rule has most likely changed, and should thus be acceptable syllable-initially (Pulgram, 1970). This cluster might not be split in all cases.

Table 4-2: Lists of stimuli for experiment three

	Item	V1	C2	V2	Final-C	Type
CVCV	défi	e	f	i	•	C
	sofa	o	f	ɑ	•	C
	calé	a	l	e	•	C
	fêlé	ɛ	l	e	•	C
	mêla	ɛ	l	ɑ	•	C
	mêlé	ɛ	l	e	•	C
	pâli	ɑ	l	i	•	C
	polo	o	l	o	•	C
	râlé	ɑ	l	e	•	C
	sali	a	l	i	•	C
	valu	a	l	y	•	C
	vélo	e	l	o	•	C
	volé	ɔ	l	e	•	C
	fana	a	n	ɑ	•	C
	fané	a	n	e	•	C
	gêna	ɛ	n	ɑ	•	C
	gêné	ɛ	n	e	•	C
	puni	y	n	i	•	C
	zona	o	n	ɑ	•	C
	zoné	o	n	e	•	C
	dora	ɔ	R	ɑ	•	C
	duré	y	R	e	•	C

	fora	ɔ	R	ɑ	•	C
	gara	a	R	ɑ	•	C
	géra	e	R	ɑ	•	C
	jura	y	R	ɑ	•	C
	juré	y	R	e	•	C
	mari	a	R	i	•	C
	paré	a	R	e	•	C
	data	a	t	ɑ	•	C
	futé	y	t	e	•	C
	gâté	ɑ	t	e	•	C
	rata	a	t	ɑ	•	C
	raté	a	t	e	•	C
	véto	e	t	o	•	C
	vota	ɔ	t	ɑ	•	C
	gavé	a	v	e	•	C
	rêvé	ɛ	v	e	•	C
	java	a	v	ɑ	•	C
	sévi	e	v	i	•	C
CVPPrV	spectral	ɛ	ktR	a	l	PPr
	spectraux	ɛ	ktR	o	•	PPr
CVPrV	décret	e	kR	ɛ	•	Pr
	écrit	e	kR	i	•	Pr
	écrou	e	kR	u	•	Pr
	micro	i	kR	o	•	Pr
	nacré	a	kR	e	•	Pr
	recrée	a	kR	e	•	Pr
	récrit	e	kR	i	•	Pr
	recrue	a	kR	y	•	Pr
	sacré	a	kR	e	•	Pr
	secret	a	kR	ɛ	•	Pr
	sucra	y	kR	ɑ	•	Pr
	sucrait	y	kR	ɛ	•	Pr
	sucré	y	kR	e	•	Pr
	après	a	pR	ɛ	•	Pr
	cyprès	i	pR	ɛ	•	Pr
	épris	e	pR	i	•	Pr
	lépreux	e	pR	ø	•	Pr
	mépris	e	pR	i	•	Pr

	repris	ə	pR	i	•	Pr
	châtré	ɑ	tR	e	•	Pr
	citron	i	tR	ɔ̃	•	Pr
	étreint	e	tR	ɛ̃	•	Pr
	flétri	e	tR	i	•	Pr
	flétrir	e	tR	i	r	Pr
	lutrin	y	tR	ɛ̃	•	Pr
	métro	e	tR	o	•	Pr
	patrie	a	tR	i	•	Pr
	patron	a	tR	ɔ̃	•	Pr
	pétri	e	tR	i	•	Pr
	pétrir	e	tR	i	r	Pr
	plâtra	ɑ	tR	ɑ	•	Pr
	plâtré	ɑ	tR	e	•	Pr
	rétro	e	R	o	•	Pr
	titra	i	tR	ɑ	•	Pr
	titrait	i	tR	ɛ	•	Pr
	titré	i	tR	e	•	Pr
	vitrail	i	tR	a	j	Pr
	vitraux	i	tR	o	•	Pr
	vitré	i	tR	e	•	Pr
	vitreux	i	tR	ø	•	Pr
CVsPV	disco	i	sk	o	•	sP
	fiscal	i	sk	a	l	sP
	fiscaux	i	sk	o	•	sP
	pascal	a	sk	a	l	sP
	aspect	a	sp	ɛ	•	sP
	crispa	i	sp	ɑ	•	sP
	crispé	i	sp	e	•	sP
	dispos	i	sp	o	•	sP
	respect	ɛ	sp	ɛ	•	sP
	suspect	y	sp	ɛ	•	sP
	castor	a	st	ɔ	r	sP
	costaud	ɔ	st	o	•	sP
	cristal	i	st	a	l	sP
	cristaux	i	st	o	•	sP
	destin	ɛ	st	ɛ̃	•	sP
	festin	ɛ	st	ɛ̃	•	sP

	fiston	i	st	ɔ̃	•	sP
	lesta	ɛ	st	ɑ	•	sP
	lestait	ɛ	st	ɛ	•	sP
	lesté	ɛ	st	e	•	sP
	lista	i	st	ɑ	•	sP
	listé	i	st	e	•	sP
	pastel	a	st	ɛ	l	sP
	pasteur	a	st	œ	r	sP
	pesto	ɛ	st	o	•	sP
	piston	i	st	ɔ̃	•	sP
	posta	ɔ	st	ɑ	•	sP
	postait	ɔ	st	ɛ	•	sP
	postal	ɔ	st	a	l	sP
	postaux	ɔ	st	o	•	sP
	posté	ɔ	st	e	•	sP
	resta	ɛ	st	ɑ	•	sP
	restait	ɛ	st	ɛ	•	sP
	restant	ɛ	st	ã	•	sP
	resté	ɛ	st	e	•	sP
	testa	ɛ	st	ɑ	•	sP
	testait	ɛ	st	ɛ	•	sP
	testé	ɛ	st	e	•	sP
	testeur	ɛ	st	œ	r	sP
	zesté	ɛ	st	e	•	sP

The four lists in Table 4-2 were combined into one and randomized. In the previous experiments carried out for this thesis, subjects had to divide the same CVCV stimuli one after another. This might have caused the French subjects to think that there ought to be variation in the way to divide the stimuli, since they were always offered three choices. Having only one stimulus structure might also have created such a monotony that it could have influenced the results. By mixing the stimulus structures, it was hoped that these factors would be neutralized.

The French stimuli were recorded individually in random order by a French speaking male announcer at Radio-Canada (Edmonton) who

was from Ontario. The recording was done in a soundproof room on a Tandberg TCR 522 tape recorder with an omnidirectional Sony ECM 50 microphone on a TDK-SA cassette. The stimuli were digitized at 11Khz with SoundEdit using a MacRecorder digitizer with no additional filters. Care was taken to leave less than 1 ms of silence at the beginning of the digitized stimuli.

The experiment was carried out on a Macintosh Powerbook 540c equipped with an external mouse, running a Hypercard stack especially designed for the study. The subjects listened to the stimuli through Sony DR-7 headphones set on monophonic binaural mode.

Procedure

All procedures were executed in French. First, it was established that subjects were able to use a computer mouse. No subject reported any hearing problems and all had used a computer mouse before. The following information was then collected from the keyboard: age, sex, province or territory of origin, L1, L2, other languages known, and age of acquisition of L2 (self-defined). Each subject's score on the colour-naming task for French and English, and on the self-evaluation test for both languages, were also recorded. This information was compiled by the computer and transferred to a file specific to each subject and to which the experimental data would later be added. The researcher, who had been present from the beginning, would then leave the subject alone to do the experiment quietly after telling the subject to put the headphones on. Instructions were presented along with one example (the word "lavé", which was not in the experimental list, was used as the example — see appendix A for a copy of the instructions). Then the experiment started. The subjects' task was to choose the division that best fit the target word heard according to the way they themselves pronounced it.

The experiment was organized as follows: For each item, the target word was played at the same time as the syllable divisions were shown in three boxes placed in the center of the screen, with a hyphen

to indicate the position of the break. The subjects had to click in the box of their choice. The next stimulus was presented one second after the click. The order of presentation and the order of syllable division alternatives in the boxes were randomized for each subject.

Results

The goal of this experiment was to determine the preferred syllable division of French subjects for four intervocalic structures: CVCV, CVPPrV, CVPrV, CVsPV. The dependent variables under study were the choice of syllable division alternatives preferred by each subject for each stimulus of each structure. The predictions made on theoretical grounds were confirmed, with a few minor discrepencies.

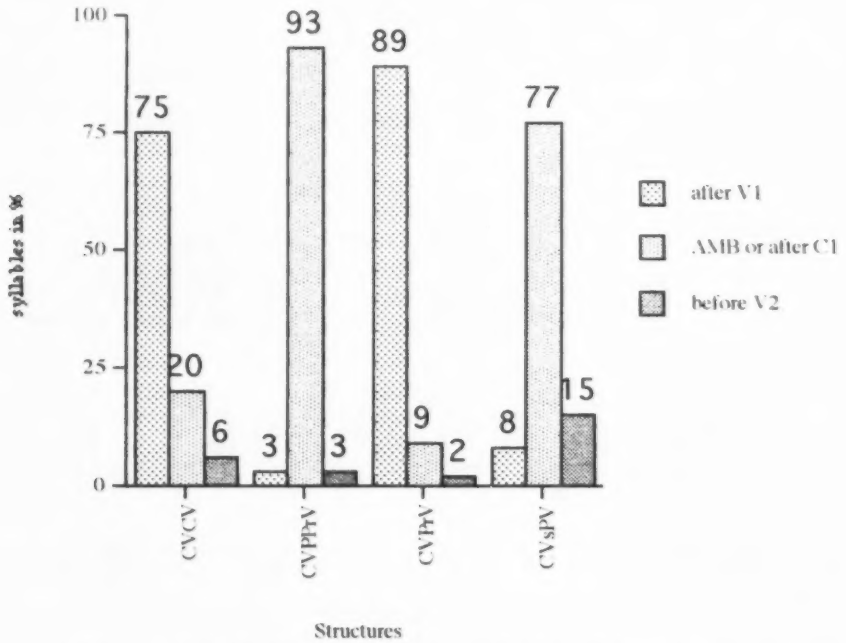


Figure 4-1: Syllable divisions of stimuli by structure

CVCV : As in previous experiments, subjects divided these stimuli as two CV groups in 75% of the cases ; 20% of the stimuli were divided as ambisyllabic (CVC.CV), and 6% as CVC.V. This pattern is very

similar to the one obtained in the previous experiments, especially the one described in chapter three.

CVPPrV : As expected, almost all of the 'PPr' clusters were divided after the first stop. Only two other individual responses were given for the other choices and they were given by two different subjects (one each). These were likely errors.

CVPrV : Once again, the predictions made for this structure were confirmed: In 89% of the cases, the 'Pr' clusters were kept together and the division occurred before the cluster. In only 9% of the cases were the clusters split. Two percent of the stimuli were divided after the cluster, probably in error.

CVsPV : The 'sP' clusters were split in 77% of the cases, a trend that reflects the prediction that some variation was expected. It must be noted that, when the 'sP' clusters were kept undivided, they did not always go with the onset of the second syllable, as 15% of the stimuli were divided after the cluster and 8% before.

Another interesting finding was that subjects of different origin divided some of the structures differently. The subjects from Saskatchewan (n = 1) and Alberta (n = 4) were combined into a new group called the "Prairies". It should be noted that the subjects from the Prairies were from French minority groups, which means that they usually learned English as an L2 early in life, whereas subjects from Québec were from a majority group and learned English as teenagers or adults. The age at which the subjects began to learn English is henceforth called "age of L2 onset". In the present study, all of the subjects from Québec learned English after the age of 9 ($\bar{X}$ = 16, σ = 3.436), whereas all of the French subjects from the Prairies learned English before the age of 10 ($\bar{X}$ = 6.8, σ = 1.722). The correlation between the region of origin and the age of L2 onset is significant (r = -.825, $df.$ = 2, p > .01). When comparing subjects from the Prairies with subjects from Québec, significant differences were found

in the way CVCV and CVPrV stimuli were divided: $F(1, 596) = 48.181$, $p = .0001$ and $F(1, 597) = 6.481$, $p = .0112$ respectively. The main difference between the two regions of origin is that Prairie subjects tended to divide syllables in the middle of consonant clusters or treated the single intervocalic consonants as ambisyllabic more often than Québec subjects did (see Figures 4-2a, 4-2b, and 4-2c). The tendency to treat the single intervocalic consonants as ambisyllabic follows the same trend as that of the English subjects in the second experiment. There were too few CVPPrV stimuli to run an analysis of variance, but the difference between subjects from the two different regions for CVsPV stimuli almost reached significance: $F(1, 596) = 2.911$, $p = .0885$.

These results indicate that the region of origin influences syllable division. We also know that there is a link between the age of L2 onset and the region of origin. To confirm the importance of the age of L2 onset on syllabification, an ANOVA was performed. The results were significant ($F(1, 1464) = 4.174$, $p = .0412$), indicating that the age of L2 onset is most likely the main reason for the different syllabification between Québec and Prairie francophones.

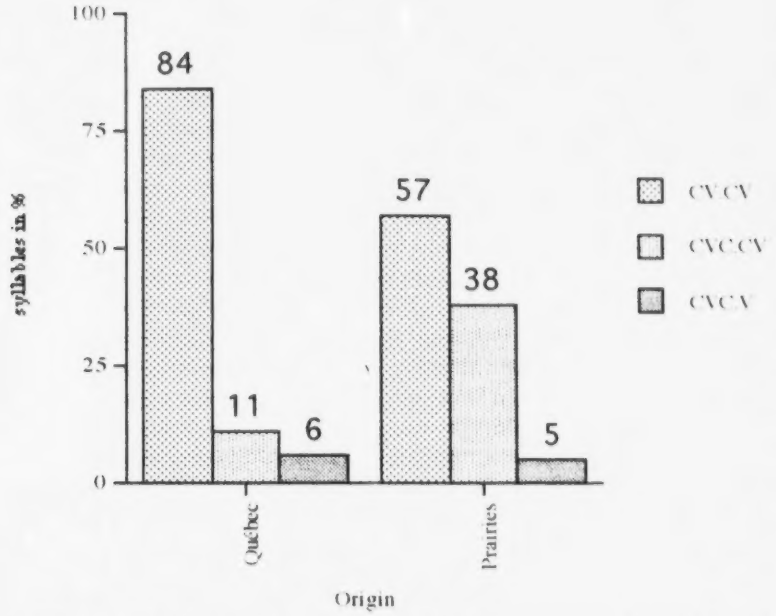


Figure 4-2a: Syllable divisions of CVCV structures by subject's place of origin

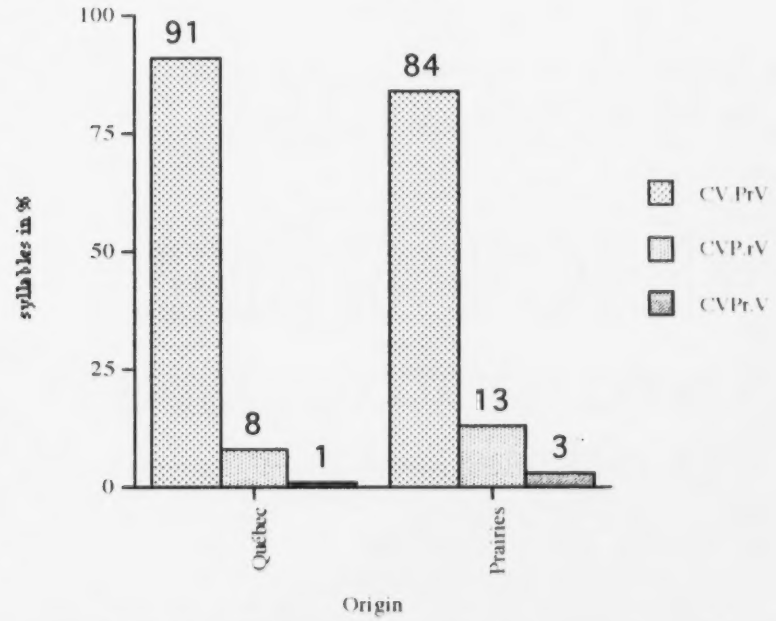


Figure 4-2b: Syllable divisions of CVPrV structures by subject's place of origin

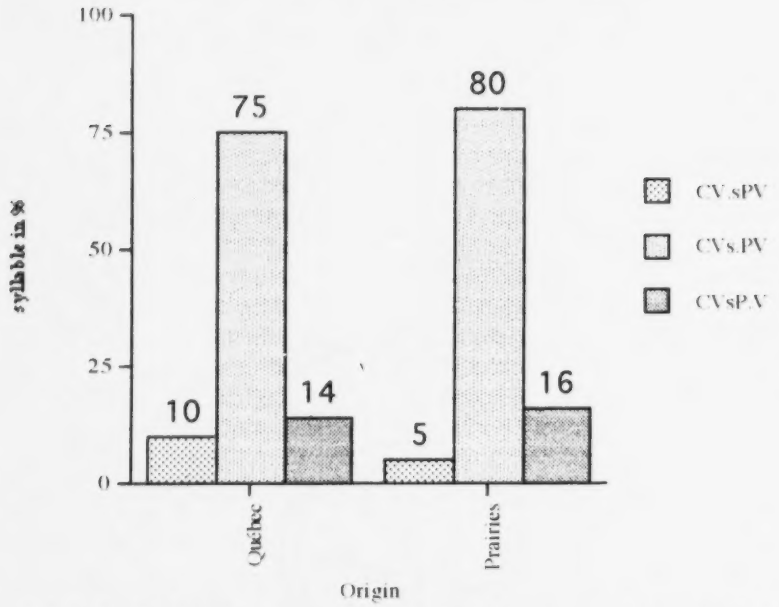


Figure 4-2c: Syllable divisions of CVsPV structures by subject's place of origin (not significantly different)

Discussion

The objective of this chapter was to pursue the analysis of the syllable preferences of French speakers for more complex structures. Four structures were studied. The predictions made earlier in this chapter regarding the syllable division of the structures under study were generally confirmed. I will now review the findings and discuss their importance for theories of the French syllable.

The predictions were based on work for French presented by Dell (1995) and Delattre (1944a; 1944b). Delattre proposed that the potential splitting of intervocalic consonant clusters was governed by the sonority of its components, keeping in mind that the favored syllable structure is open (i.e. with no coda). Dell proposed another rule, that is, that a syllable could have at most one consonant as coda. The remaining consonants would thus be part of the next syllable,

except in the case of a stop + liquid cluster, which was considered by Dell as a single consonant and thus unbreakable. The two approaches are not contradictory, though they sometimes lead to different predictions about how complex clusters should be divided.

The first of the structures studied was the CVCV stimuli. These stimuli were judged to have the same structure as those used in previous experiments. They were used again to gain certainty about these judgments and to verify the regularity of the results, despite some variations in the application of the protocol. In previous experiments, only this structure was studied. Although subjects might have been tempted to divide the stimuli as two CV syllables 100% of the time, they could have been confused by the fact that they were given three choices of alternative syllable divisions. In the present experiment, the stimuli of all four structures were mixed at random, diluting the potential confusion that some subjects could have felt in previous experiments. Furthermore, varying the structure of the stimuli certainly reduced the monotony of the task.

The results obtained in the present experiment for the CVCV stimuli were consistent with those of previous experiments. The stimuli were divided after the first vowel (CV) in 75% of the cases. Another 20% of the cases were divided as ambisyllabic, that is, the intervocalic consonant was kept both as the coda of the first syllable and as the onset of the next one. A remaining 6% of the cases were divided after the intervocalic consonant, leaving the next syllable without an onset. The similarity of results with previous experiments and the fact that results go in the same direction as those obtained by other researchers (Kolinsky et al., 1995; Marouby-Terriou & Denhière, 1994) indicate that the monotony factor and the potential confusion created by the constant presentation of three choices were probably not influential in the protocol used here — the pause-break experiment.

Furthermore, the results obtained for CVCV stimuli are generally consistent with Delattre's rule. The 25% of discrepancies may come

from three hypothetical sources: (1) an experiment based on perceptual preferences is likely to have a certain level of error, as with the CVPPrV stimuli; (2) the geographical variation measured in the present experiment may also be at play between Europe and Canada. Indeed, Delattre developed his teaching for "International French" (which usually means a generic European French). However, it is possible that the syllable in Canadian-French is different from its counterpart in International French, in part because of the former's more constant contacts with English; (3) a morphological effect could also be involved here, as we will discuss shortly.

Despite these discrepancies, it can nonetheless be concluded that bisyllabic words having a single intervocalic consonant are generally divided before that consonant, leaving the first syllable without a coda (open syllable). Future studies should focus on the possibility of generalizing the present pattern of results to longer words.

The second structure studied was the CVPPrV stimuli. One has to keep in mind that only two stimuli were used here, impeding the generalizability of the results. The structure was thus used here only as a control for the protocol. Indeed, this structure is very unlikely to be divided in any other way than CVP.PrV because the sonority of the two stops will always be greater than that of the /R/ that follows them. Thus, by comparing the results obtained from subjects, an estimate of the error rate in the present application of the pause-break experiment can be done.

The results obtained for the CVPPrV stimuli are quite revealing, as only 6% of deviation from the prediction was found. It can thus be concluded that the present application of the pause-break protocol leads to less than 10% of error. A larger number of items with such a structure would have been valuable to increase the accuracy of the estimate of error; however, bisyllabic words with such a structure and with the restrictions that were posed in the methodology are rare. This

sort of estimate of error should be more commonly used in perceptual research.

The third structure studied in the experiment presented here was the CVPrV stimuli. Stop + liquid clusters are said to be unsplitable (Dell, 1995). It was therefore predicted that the stimuli with such a structure would be divided before the cluster. Of course, division after the cluster is also possible in theory, according to Dell. However, Delattre (1944a; 1944b) states that syllables tend to remain open in French, reducing the possibility of finding divisions such as CVPr.V.

These predictions were all widely confirmed. The vast majority of CVPrV structures were divided before the intervocalic consonant cluster (89%), while a mere 2% were divided after the cluster, which supports the arguments of Delattre. However, 9% of the clusters were split, which contradicts Dell's rules. There is a good possibility that the 9% and 2% of divergent syllable divisions were simple error, but there is no way to confirm this. There was also a hint of a potential morphemic effect; i.e., some subjects could have divided stimuli into two morphemes instead of dividing them into two syllables, since the instructions only said "to give their preferred way to divide the word in two". However, note that for words like "vitré" or "sucra" such a strategy would lead these words to being parsed as "vitr-é" and "sucr-a". Interestingly, as will be documented below, such divisions constituted only 2% of the cases where a morphological effect was a possibility.

It thus appears safe to conclude that intervocalic stop + liquid clusters are unlikely to be split, and that the syllable division will occur before the cluster. Such a conclusion is consistent with both Delattre (1944a; 1944b) and Dell (1995).

The fourth and last structure studied was the CVsPV structure. It was predicted that the intervocalic /s/ + stop cluster would be split

because (1) the sonority of /s/ is higher than that of the stop, which is not possible within the same syllable in French (Delattre, 1944a; 1944b); and (2) if at most only one consonant can be in a coda (Dell, 1995), then the stop must be the onset of the next syllable.

These predictions were in general supported by the results. Indeed, 77% of the clusters were split, a probable reflection of the rules of Delattre and Dell. However, 23% of the clusters were not split; and these cases represent an important proportion that requires some explanation. More specifically, 8% of the cases were divided before the cluster (CV.sPV, which respects the open syllable rule of Delattre) and 15% were divided after the clusters. Judging by the error rate estimate established by the CVPPrV structure, this latter 15% figure is probably too high to be attributed to unsystematic errors.

Morphological effect

Because a relatively large variation was found in CVCV and CVsPV structures in the previous experiment, and because a morphological factor was found to influence the syllable division in English (Derwing, 1992), it was felt that a test should be done to assess a potential similar morphological effect in French. Because the subjects who participated in the present study were asked to divide the stimuli with no specifications on how to do it, it is possible that a portion of them used morphological information as one possible basis for division. To perform an ideal analysis on the potential effect of morphology on the performance of these subjects, it would have been necessary to know which stimuli they identified as having two morphemes and where they established the morphemic division, instead of relying on the experimenter's intuition or on some historically-determined notion of the morpheme division. However, this information was not collected at the time the syllable division experiment was conducted. A new experiment was thus carried with a different group (taken from the same population), given that the original subjects could not be located. This new sample (henceforth called the Morph sample) was composed of 22 francophone subjects

(12 from the Prairies, 7 from Québec, 2 from Ontario, and 1 from the Maritimes — speaking Canadian-French, not Acadian-French) who were also studying at Faculté Saint-Jean. Their task was to divide the same words as those used in the main experiment of this chapter into "meaning units". The list of words was presented to them on a sheet of paper, and they were asked to divide the words into two meaning units (whenever possible) by drawing a slash through the words at the appropriate point (e.g., "anti/gel"). They were also asked to do nothing to words with a single meaning unit and to write a question mark beside unknown words. They were given the following practice items to familiarize themselves with the task: antigel, tablette, trouvait, coureur, mangeoire, importation, blessure, héritage. The order of the stimuli on the list was random but the same order was used for all subjects.

The results of this morphemic division as done by the Morph sample were compiled manually. A frequency of each possible morphemic division for each stimulus was thus obtained. The following criterion was set arbitrarily: 70% or more of the subjects had to give the same morphemic division location in order for the division to be considered a homogeneous one. Out of the 122 stimuli of the list, 24 were discarded because of lack of agreement on the locus of the morphological division. Of the remaining stimuli, 70 stimuli were judged as bimorphemic and 28 were monomorphemic. The morphemic divisions prefered by the Morph sample reflected exactly those of the experimenter. All morphemic divisions for bimorphemic stimuli were made at the same place (immediately before the second vowel, e.g. "rest/ait", "gên/é"). For simplicity's sake, the representation of this effect in figures will thus be identified as "number of morphemes".

The number of morphemes of the stimuli was added to the data set of the main experiment of this chapter as a separate variable. This was done by sorting the data set according to the stimuli, by adding a column, and by entering the morphemic information corresponding to each stimulus in the cells of this new column. Monomorphemic stimuli

were indicated by giving the value "1" and bimorphemic stimuli were given the value "2". A one-way ANOVA was carried out to test the effect of the morphemic variable on the syllabic response. The dependent variable was the syllabic response given by the subjects of the main experiment of the present chapter and the independent variable was the number of morphemes. There was a significant morphemic effect for all subjects: ($F(1, 1464) = 17.980$, $p = .0001$), for subjects from Québec ($F(1, 975) = 9.540$, $p = .0021$) and for subjects from the Prairies ($F(1, 487) = 9.132$, $p = .0026$). Monomorphemic stimuli generally led to syllabic divisions that more closely mirrored the theoretical predictions, that is, monomorphemic CVCV stimuli had more CV.CV divisions, monomorphemic CVPrV had more CV.PrV divisions, and monomorphemic CVsPV had more CVs.PV divisions than their bimorphemic counterparts. As can be seen in Figures 4-3a, 4-3b, and 4-3c, the effect is, however, more marked for subjects from the Prairies; the interaction between the morphemic division and the regional origin of the subjects is also significant ($F(3, 1462) = 12.270$, $p = .0001$).

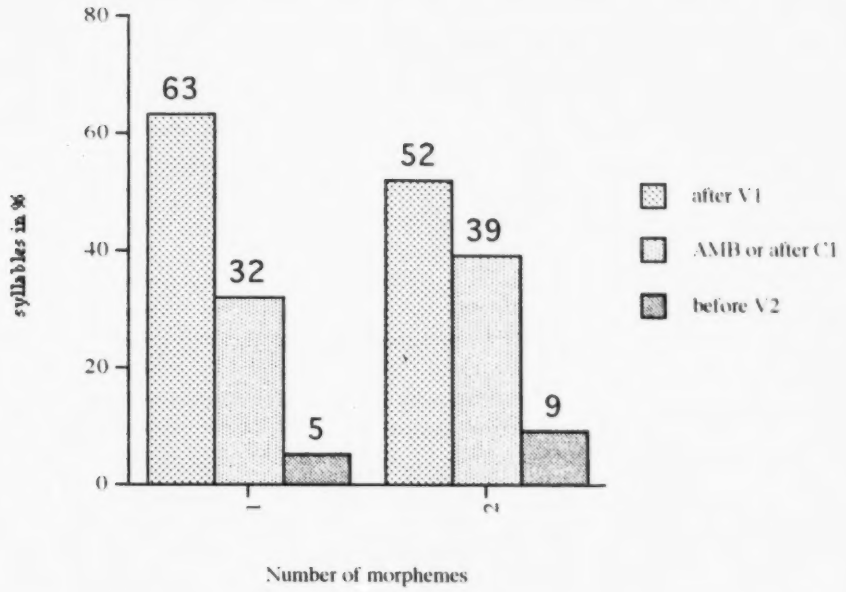


Figure 4-3a: Syllable divisions as influenced by the number of morphemes for all subjects

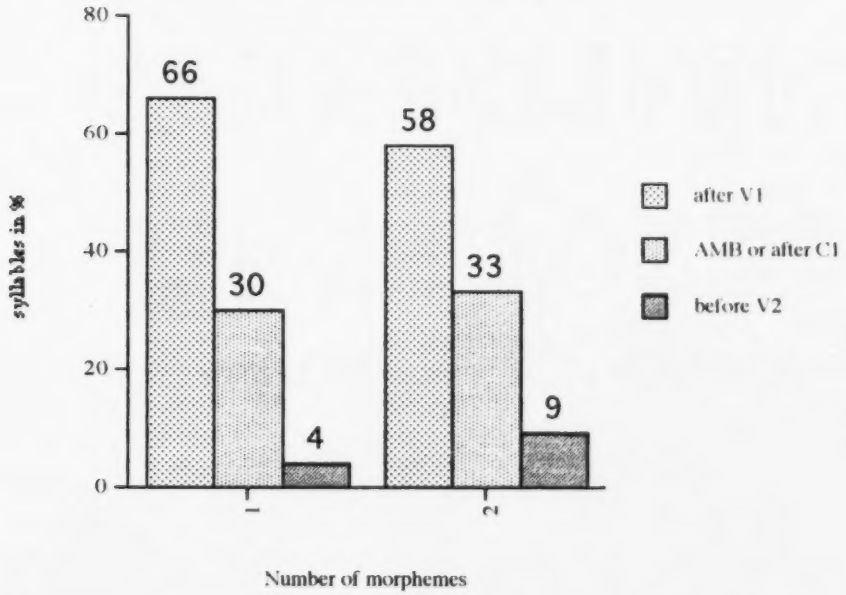


Figure 4-3b: Syllable divisions as influenced by the number of morphemes for subjects from Québec

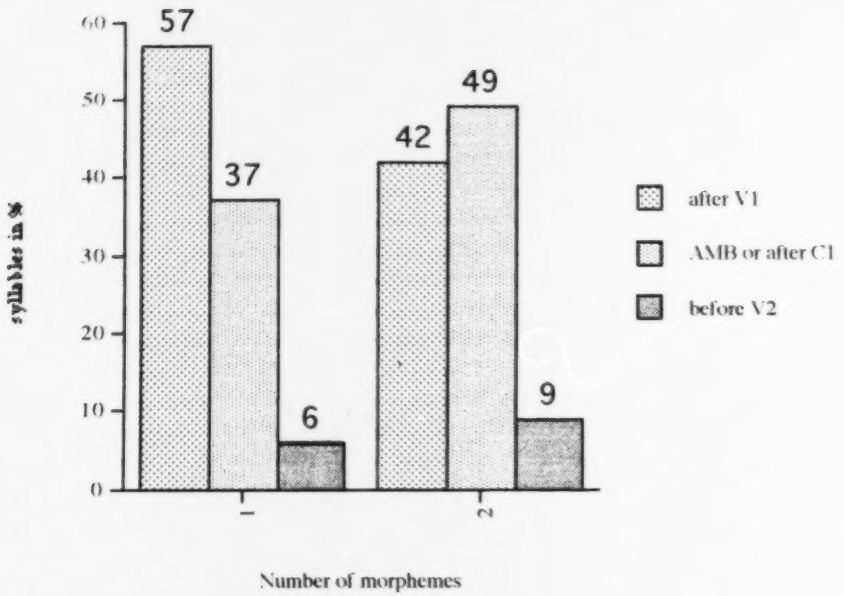


Figure 4-3c: Syllable divisions as influenced by the number of morphemes for subjects from the Prairies

It thus appears that morphology had an effect on the results of this part of the present experiment. This effect could be explained by proposing that, when French speaking subjects are asked to divide words (with no further specifications), there is a good chance that they will use morphemic information if the stimulus has more than one morpheme, but they will use syllabic information if the stimulus is monomorphemic. Given that morphology is known to influence syllable division in English (Derwing, 1992), the difference in syllable division as performed by the groups of subjects is likely to be caused by the the fact that francophones from the Prairies are exposed to English at an earlier age than Québec francophones.

In attempting to explain the variation found among the different stimulus structures, a one-way ANOVA was conducted to test the effect of the morphemic variable on the syllabic response for the CVCV, CVsPV, and for the CVPrV structures. All of the CVPPrV were judged as bimorphemic and no analysis was necessary or

possible. The effect of morphology on CVsPV and CVPrV structures reached significance: $F(1, 462) = 4.001$, $p = .0460$ for CVsPV; $F(1, 402) = 8.281$, $p = .0042$ for CVPrV. The morphological effect on CVCV stimuli almost reached significance ($F(1, 566) = 3.847$, $p = .0503$. In all cases, the monomorphemic stimuli led to results closer to the syllabification predictions than did the bimorphemic stimuli (i.e., monomorphemic CVCV stimuli have more CV.CV divisions, monomorphemic CVPrV had more CV.PrV divisions, and monomorphemic CVsPV had more CVs.PV divisions than their bimorphemic counterparts — see Figure 4-4a, 4-4b, and 4-4c).

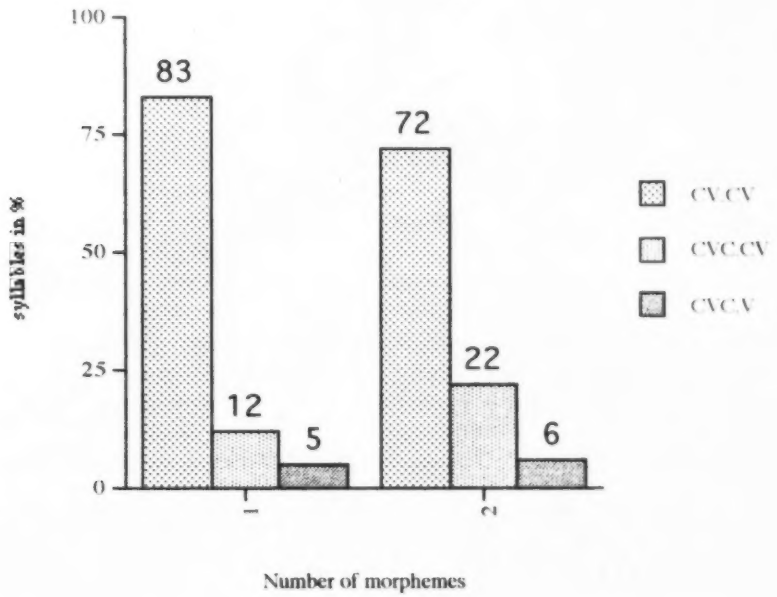


Figure 4-4a: Syllable divisions of CVCV stimuli as influenced by the number of morphemes for all subjects

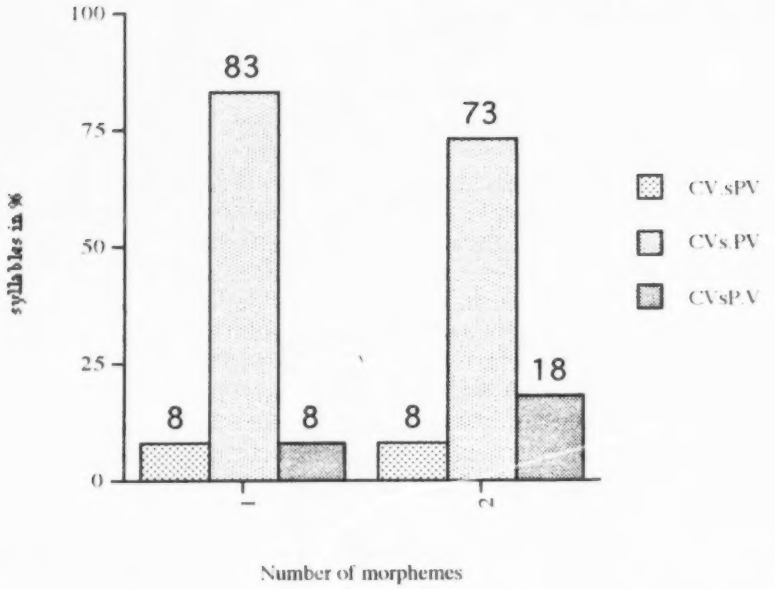


Figure 4-4b: Syllable divisions of CVsPV stimuli as influenced by the number of morphemes for all subjects

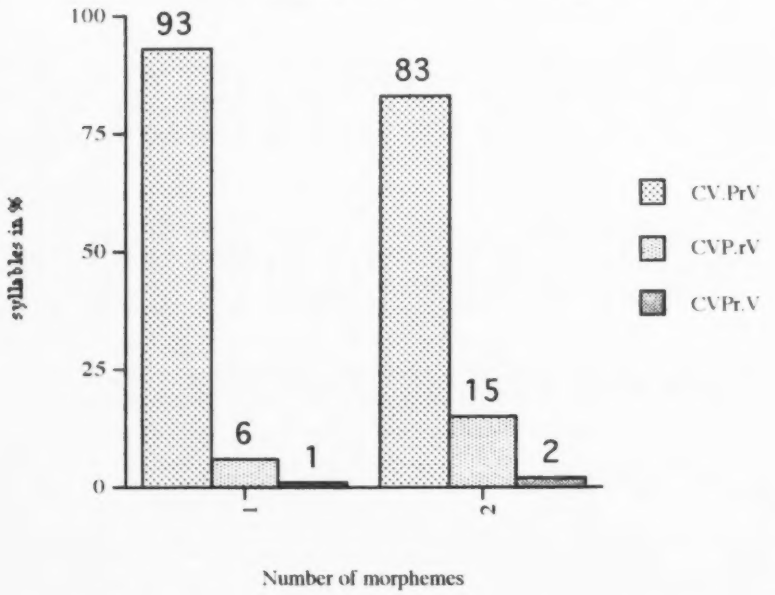


Figure 4-4c: Syllable divisions of CVPrV stimuli as influenced by the number of morphemes for all subjects

To test the effect of morphology as individual items, systematic comparisons were made between the divisions that would have been made by the subjects of the main experiment on the basis of syllable structure with those made on the basis of morphological structure. If a subject were to divide according to syllable structure, the favoured division should reflect the division predicted by Delattre and Dell. However, a division based on morphological structure should be made right before the second vowel, i.e., at the morphological boundary. Table 4-3 clearly shows that very only few stimuli divisions were more strongly influenced by morphology, and seldom did this influence exceed 20% of the strings (see column M1 in Table 4-3). The divisions that seem to have been influenced the most by morphology were all found in the 'sP' structures, except for "paré" which reaches 20% of division based on morphology. The percentage of agreement on the locus of morphological division has also been included in the table to indicate how clearly the morphological boundary is perceived by subjects of the Morph sample. For example, the stimulus "calé" was divided by the main group as "ca-lé" (which respects the syllabic prediction) 60% of the time, and as "cal-é" (which respects the morphological prediction) only 7% of the time. Among the Morph sample, 87% of the subjects agreed that the morphological division of "calé" was "cal-é" (see column M2 in Table 4-3).

Table 4-3: List of bimorphemic stimuli with their percentages of syllable judgements made by the initial group of subjects that followed the syllable predictions (S) and the morphological predictions (M1). M2 is the proportion of agreement on the locus of morphological division of the stimuli by the second group of subjects

	Items	S	M1	M2
C	calé	60	7	87
	data	73	7	70
	dora	67	13	87
	duré	80	7	87
	fana	60	7	74
	fané	53	7	87
	fêlé	67	7	87
	fora	50	7	78
	futé	87	0	70
	gara	93	0	83
	gâté	100	0	96

	gavé	73	7	87
	gêna	67	7	96
	gêné	67	7	100
	géra	67	7	87
	jura	73	13	91
	juré	87	0	96
	mêla	60	7	91
	mêlé	67	0	100
	pâli	80	13	78
	paré	60	20	91
	râlé	67	13	96
	rata	67	0	83
	raté	93	0	96
	rêvé	80	7	87
	sali	73	7	87
	valu	73	0	78
	volé	60	0	100
	vota	73	7	87
	zona	87	0	70
	zoné	67	13	100
Pr	châtré	93	0	91
	nacré	87	0	78
	plâtra	80	7	83
	plâtré	93	0	83
	sacré	93	0	96
	sucra	80	0	96
	sucrait	73	7	100
	sucré	67	0	91
	titra	87	0	87
	titrait	80	7	100
	titré	73	0	91

	vitrail	73	7	74
	vitraux	93	0	96
	vitré	87	0	100
	vitreux	87	7	96
sP	crispa	60	27	83
	crispé	67	13	91
	cristaux	73	20	74
	fiscaux	87	7	74
	lestait	73	13	87
	lesté	80	7	87
	lista	67	27	91
	listé	67	13	100
	posta	60	33	96
	postait	67	20	100
	postal	73	27	78
	postaux	67	33	96
	posté	93	7	96
	resta	73	20	87
	restait	60	27	96
	restant	86	7	100
	resté	73	20	100
	testa	73	20	87
	testait	73	27	100
	testé	87	7	96
	testeur	80	13	96
	zesté	67	27	70
PPr	spectral	100	0	74
	spectraux	87	7	100

These results reveal that the percentage of divisions that fall between a morphological division and a syllable division (i.e., the divisions where a consonant cluster was broken or where a single intervocalic consonant was treated as ambisyllabic) is sometimes high. The word "calé", for example, yielded 33% ambisyllabic judgments. One possible explaination for that is to hypothesize that syllable

structure interacts with morphological structure, so that both influence the divisions obtained from subjects. One could therefore expect the division of bimorphemic stimuli to bring more ambisyllabic judgments than the division of monomorphemic stimuli. In the present analysis, only CVCV and CVPrV stimuli were included in the table because all CVPPrV stimuli were bimorphemic, and ambisyllabic judgments for CVsPV stimuli constituted the theoretical syllable prediction. The expected difference in the proportions of ambisyllabic judgments between bimorphemic and monomorphemic stimuli appears to be confirmed for most subjects (except for subject fxb), with subjects 'dyz', 'jyw', and 'wgl' showing the largest differences (see Table 4-4). Future research should investigate the possibility that subjects use a combination of morphological and syllable information when they divide words, although the relative importance of each varies among subjects. Doing so, the subjects faces a difficult choice because neither the syllable division nor the morphemic division will satisfy them; they thus select the ambisyllabic judgment because it constitute a compromise between the syllable and the morphemic division.

Table 4-4: List of monomorphemic (Mono) and bimorphemic (Bi) words from the initial group with the percentage of ambisyllabic judgments that each subject made (CVCV and CVPrV stimuli only)

Subject	Mono	Bi
bmq	14	23
dyz	23	60
fbb	23	27
frf	0	2
fvt	0	2
fxb	23	17
jyw	8	41
lbx	0	2
mky	4	18
smg	0	3
sqc	7	16
vpv	0	0
wgl	26	47
xph	0	0
ysl	7	18

To show the extent of the influence of morphology on word division, an analysis of the proportions of divisions that would have been made by each subject of the main experiment on the basis of syllable structure or on the basis of morphological structure was performed. Table 4-5 shows that only one subject was strongly influenced by morphological structures (subject 'mky'). It thus appears that, overall, the morphological effect influenced most subjects in a significant but discrete way.

Table 4-5: List of subjects from the initial group with the percentage of syllable judgments that followed the syllable predictions (S) and the morphological predictions (M) for bimorphemic stimuli (all syllable structures combined). The remainder (unshown) of the judgements yielded ambisyllabic divisions.

Subject	S	M
bmq	83	2
dyz	40	15
fbb	61	18
frf	83	14
fvt	99	0
fxb	85	4
jyw	54	17
lbx	97	2
mky	55	33
smg	93	0
sqc	76	13
vpv	71	2
wgl	67	0
xph	100	0
ysl	73	15

The morphemic effect found here suggests that variation and interactions between factors are to be expected if the linguistic task required from subjects is not specific enough. By not wanting to influence the decisions that subjects would make in the present study, we ran the risk of not being able to fully analyze the results. Asking the subjects to "divide the words in two" led some subjects to rely on morphological information when possible, whereas we were looking for syllabic information. This shows that subjects performing a task are aware of both the meaning and the form of the stimuli, and this should be considered in developing experimental materials in the future.

Previous research (among others, Cutler et al., 1986; Cutler et al. 1992; Kolinsky et al., 1995) took for granted that the division of French stimuli that their subjects performed followed only the rules set

by Delattre (1940; 1944a; 1944b). In these studies, the subject's task was typically to identify words presented aurally that start with a string of letters displayed on a screen in front of him/her (i.e., to press on the button that stops a timer when the string 'BAL' is seen and the word "balcon" is heard). The prediction is that a match between the initial syllable of the word and the string displayed would lead to faster reactions than a mismatch (as the mismatch between the string 'BAL' and the word "ballon"). This prediction thus assumes (a) that the syllable structure of the words presented is known, and (b) that no other factors influence the division of words. However, the stimuli used in these researchers allowed divisions that may have been influenced by other factors such as spelling or morphology. For example, "palmier" and "gardien" (Cutler et al., 1992) would be divided as "palm-ier" and "gard-ien" on a morphological basis, but as /pal.mje/ and /gaR.djɛ̃/ on a syllabic basis. Since these linguistic factors interplay with syllable division, it is not clear that these experiments revealed only syllable division, because of lack of control for additional linguistic factors.

Finally, there is one other point to be made regarding the differences in syllable preferences found in CVCV and CVPrV structures, and the importance of the morphological effect between subjects from Québec and subjects from the Prairies. It should first be noted that the size of the groups is not balanced. In spite of this imbalance, similar differences were found in an unpublished pilot study (likewise using imbalanced groups) performed a few years ago on a small sample of subjects, keeping in mind the lack of balance between the two groups (Beaudoin, 1994 — see appendix B for a copy of the manuscript). These studies suggest that the fact that Prairie francophones learn English at an earlier age may influence the way they divide words. This is another example of the influence of an L1 structure on a L2 structure. Further study is necessary before any further conclusions can be drawn at this point.

Summary

The results of the present study suggest three things: (1) predictions made on theoretical grounds are in the present case generally corroborated by perceptual experiments; (2) a morphological effect that explains part of the variation is found in the present experiment; and (3) French subjects from various regions of Canada divide some syllable structures in different ways, probably because of the difference in the age of L2 onset among the regional groups. More specifically, the main syllable division findings were that (1) single intervocalic consonants are generally preferred as the onset of the following syllable; (2) intervocalic clusters consisting of stop + /R/ are usually kept intact as the onset of the following syllable; and (3) intervocalic /s/ + stop clusters are split most of the time.

Taken together, these results confirm that the rules developed by Delattre for French syllables are in general supported by our results and can thus continue to be used in F.S.L. classrooms with increased confidence. Although some qualification can now be added to these rules (especially concerning the effect of morphology and the number of letters used to spell intervocalic consonants in the division of French words), these discrepancies are normally not vital to the L2 learning situation.

Furthermore, the results makes us realize that when subjects speak languages other than the one under study, these other languages can influence the results of the experiments. Unfortunately, the information about other languages spoken by the subjects is seldom provided in linguistic research. It can be and should be asked for and taken into account.

The lack of a perfect fit found here between the theoretical predictions and the experimental results reflects the inadequacy of performing either theoretical or experimental research independently. It shows the importance of experimental testing of theoretical analysis.

Although experimental research is criticized because the thought process during a linguistic task is indeed unknown, the regularity of the results gives a good idea of tendencies. On the other hand, theoretical research alone cannot infer that an abstract and often complex linguistic process is performed by naive subjects because information such as historical development of the language are most often unknown to them. Theory and experimentation go hand in hand, helping each other to a better understanding of phenomena.

Chapter 5

General conclusions

The primary goal of this research was to test the syllable division preferred by French L1 and L2 speakers through a series of oral/written forced-choice syllabification tasks (pause-break experiments). The syllabification rules currently used in French were presented by Delattre for pedagogical purposes in the first half of this century and their perceptual correlates had never been verified. Testing the French syllabification rules is an important step in the study of the learnability of L2 syllable structures by English learners of French. The following is an overall review of the three experiments described in the previous chapters and a comparison with previous work done on the syllable.

The first goal set in the introduction was to assess the syllable divisions for L1 French speakers using an experimental design. The protocol selected was an oral/written forced-choice syllabification task, which consisted in playing a stimulus to the subjects and asking them to indicate their preferred division of that stimulus by picking one of the three available choices. The variant used was run on a computer to allow proper randomization, to simplify the task and the data processing, and to reduce the errors associated with data transcriptions. The entries made by the subjects were automatically treated and registered by the computer. Furthermore, the computer managed time delays in a more regular and accurate way than humans do. The three syllable division alternatives were presented visually in the last two experiments since the first experiment showed that whether the alternatives were presented visually, auditorally or both ways did not change the results significantly, although there may be a

slight over-estimate of ambisyllabic syllables and an under-estimate of CV syllables with the visual presentation. The visual mode of presentation also saves a lot of time for the subjects and for the researcher.

The first two experiments focused on the most common structure, the single intervocalic consonant presented here as CVCV. The last experiment used this structure to allow comparison with the first two experiments and also included three other word structures: CVPPrV, CVPrV, and CVsPV. The results of these three experiments lead to the conclusion that the predictions made on theoretical grounds (i.e., Delattre, 1940; 1944a; 1944b; Dell, 1995) are accurate overall, despite small variations. As predicted, CVCV words were generally divided as two CV syllables, CVPPrVs were divided as CVP.PrV, CVPrV were divided as CV.PrV, and CVsPV were divided as CVs.PV. There was, however, up to 25% variation from these predictions. Although variation in the results is to be expected in a perceptual study such as the pause-break experiment, some of the variation is too high to be attributed to pure error. I have arbitrarily accepted 10% as an acceptable margin of error for this type of task. This choice was confirmed by the results for the CVPPrV structure, which contains only one plausible division point. I will now try to explain the variation for each of the structures.

In all three experiments, CVCV words in which the intervocalic consonant is spelled with one letter were divided by French L1 speakers as two CV syllables in 72% to 85% of the cases. As mentioned earlier, variables such as the region of origin, the method used in learning to read, etc. may influence the subjects' responses. The third experiment showed that such factors (especially the province of origin, and thus the age of acquisition of L2) are indeed influential on some structures. It is therefore conceivable that variation is to be found between dialects of different countries, since speakers of these dialects may be exposed to other languages surrounding them.

To my knowledge, the effect of morphology on syllabic division had not been studied for French. The present study shows that the morphological structure of the bimorphemic stimuli is indeed influential for all complex structures. A significant effect exists whereby monomorphemic stimuli lead to judgments that are closer to the theoretical prediction (17% of variation for CVCV and for CVsPV, 7% for CVPrv) than bimorphemic stimuli. It was also found that francophones from the Prairies seem to use morphological information to a greater extent than francophones from Québec.

As shown in the first experiment, the number of letters used to spell intervocalic consonants is another important factor: Doublets lead to more ambisyllabic divisions in French, just as in English (Derwing, 1992). It is conceivable that some of the subjects might not have known the proper spelling of some words and thus might have thought that some of the singlets were doublets. This being a possibility for a minority of the cases, it is possible that a portion of the ambisyllabic divisions given by the subjects are the result of spelling errors. One way to test such possibilities is to give a recall test immediately after the pause-break experiment and to verify the spelling of the stimuli recalled.

Another possible explanations for the variation observed in the first two experiments is that subjects might have felt that there ought to be variation, since they were provided with three choices throughout. This possibility has been shown to be unfounded by the third experiment. Although subjects were exposed to four different stimulus structures distributed at random, they still syllabified the CVCV stimuli the same way as in the first two experiments.

To sum up what was found concerning the stimuli with a single intervocalic consonant, it can be said that they are generally syllabified before the intervocalic consonant as Delattre proposed in the early forties. Deviation from that general rule originates in part from the morphological structure of the stimuli, in part from spelling, and in

part from differences among subjects of age of L2 onset. Future studies should make sure to control these factors and to test the possibility of spelling errors by some subjects.

The CVPPrV structure was introduced in the last experiment to estimate the error rate in the subjects' syllabification, since it is very unlikely to syllabify in any other way than as CVP.PrV in French in the light of Pulgram's (1970) principle, namely that an acceptable syllable-initial structure is also found word-initially and that an acceptable syllable-final structure is also found word-finally (see also Dell, 1995). Therefore, any other syllabification can likely be considered as an error. In fact, very little variation was found for this structure: only 3% of CVPP.rV responses and 3% of CV.PPrV responses were given. It is true that only two stimuli were used but they were distributed at random among the other stimuli. It is thus believed that the error rate is rather low in pause-break experiments, somewhere on the order of 10%. Any deviation above that rate from the expected value must be explained.

The prediction proposed for CVPrV structures came from the theoretical work of Dell (1995), who proposed that the 'Pr' cluster could not be split because it acted as a single consonant. Similar predictions were made by Delattre (1940) on the grounds of the sonority of the components. Both of these predictions were widely confirmed. There were 9% of CVP.rV division and 2% of CVPr.V, which is too low to be considered a serious deviation.

The predictions concerning CVsPV stimuli were that the consonant clusters would be split in keeping with Delattre's sonority hierarchy and Dell's rule about the limits of the composition of codas. These were also generally confirmed, although the variation was high (23%). Follow-up research showed that a portion of this variation resulted from the fact that bimorphemic stimuli were given CVsC.V judgments more often than monomorphemic stimuli (18% and 8%, respectively).

As can be seen, the theoretical predictions were largely confirmed by the experimental testing done here. In the case of French at least, it seems possible to say in answer to the remark made by Lowenstramm (1981) cited before that the distinction between the "pretheoretical ... intuitive" syllable and the theoretical syllable appear to be less clear than he suggests. The structures that Delattre proposed be taught in L2 classes can thus continue to be used without fear of misleading students.

Despite the fact that L2 learners of French appear to use a syllable structure close to that of L1 speakers of French, significant differences were found in their syllabification of CVCV syllables. Among other things, English speakers learning French do not use the phonemic components (the degree of tenseness in vowels and the manner of articulation of consonants play a role in English syllabification but not in French, as shown in experiment two) of the stimuli in the syllabification, despite the fact that they actually use them in their L1 and despite the fact that English monolinguals use them both in French and in English. This alone is an important finding. It shows that the L2 learners are capable of learning fine phonetic characteristics.

The difference in syllabification between L1 and L2 speakers of French is mostly in the higher proportion of CVC syllables (which is up to twice as high in French L2 as in French L1 speakers), and the lower proportion of CV syllables. This is compatible with the idea from contrastive analysis that the syllable division preferred by L2 speakers is a compromise of the L1 structure and the target L2 structure (i.e., an interlanguage; see Tarone,1980 and Flege, 1994). It is not possible at this point to test whether or not learners of French as L2 can eventually acquire the French syllable structure entirely, but specific training could be devised to facilitate such a goal. However, conscious and explicit learning of the syllable structure may in turn influence the choice of an experimental protocol because, by learning to syllabify, these subjects also learn to answer as they are "expected to" in most syllabification tasks.

Future studies on the French L1 syllable should include a focus on the potential effect of social factors such as dialectal variation on the structures, the influence of the alphabetization methods used in learning to read, etc. Care should be taken to control the number of letters of the intervocalic consonants because it was found to influence the syllable division of the subjects in experiment one. Phonetic factors such as the manner and place of articulation, the voicing of intervocalic consonants, and the nature of vowels on either side of those consonants, should also be studied more systematically, even if the results in the present research do not support their influence on French L1 syllabification. The control of the number of morphemes in the stimuli also appears to be critical; only monomorphemic stimuli should be used if the goal is to test syllabic division.

From a methodological point of view, this study has shown that the pause-break experiment (Derwing, 1992) can be successfully performed while presenting the syllable division alternatives visually on a computer, which saves time and allows more regularity in the presentation of the choices. This version of the protocol leads to results that are comparable to the appropriate portion of the English syllabification tests done by Derwing. In addition, a minimal error rate was established in experiment three when testing the syllable structure of CVPPrV stimuli.

The present results raise concerns about some studies (among others, Cutler et al., 1986; Cutler et al. 1992; Kolinsky et al., 1995) that assume that the French syllabification rules apply on their own. The authors studied the syllable structure of French by analysing the reaction-time required to identify a string of letters that corresponded or not to a given syllable. They concluded from their results that "Only the French-dominant group showed syllabic segmentation and only with French language materials." (Cutler et al., 1992: 381) However, it is clear now that external influences operate on the division of words in French just as in English. Among other things, this thesis has shown that morphology, spelling, and region of origin (or age of acquisition of L2)

all can influence the division of words. Some of the stimuli used by Cutler et al. (1992) are more likely to be affected than others: words such as "palmier" and "gardien" are clearly bimorphemic, and the morpheme boundaries ("palm-ier" and "gard-ien") do not occur at the same place as the syllable divisions assumed by Cutler et al. (1992) (/pal.mje/ and /gaR.djɛ̃/). Nonetheless, the authors analyzed their results as though only the syllable structure was at play. This lack of control is likely to affect the results, especially when the list of stimuli contains only ten French experimental stimuli as in Cutler's study.

The results obtained on L2 learning of French were also consistent with the predictions. A contrastive analysis predicted that English speakers learning French as L2 would syllabify French words as if they were making some compromise between the syllable division rules in the two languages. This prediction was confirmed. It was also believed that balanced bilinguals would likely syllabify as L1 speakers in both languages, but this expectation was only partially supported. In general, the syllable **division** of balanced bilinguals was the same as that of L1 speakers in both languages. However, balanced bilinguals did not make use of **phonemic components** such as the manner of articulation or vowel tenseness to syllabify English stimuli as English monolinguals did.

Because it is generally believed (Delattre, 1940; Trammell, 1993) that proper syllabification helps improve general pronunciation, and because this dissertation has shown that the syllable structure can at least in part be acquired, instruction on syllable structure could be made more systematic and should be included in most French pronunciation methods. At present, some methods (e.g., *Bien entendu!* by Albert Valdman, 1995) cover syllable structure whereas other don't (J.-G. Lebel's method and *Plaisir des sons*, Alliance Française). It appears that it would be advantageous to increase the importance of syllable division in the French L2 curriculum. The syllable division rules taught should follow those of Delattre (1940; 1944a; 1944b). Specific and explicit training on syllable division is likely to allow L2 learners to get even

closer to the French L1 syllable division. By focussing on the syllable, French L2 teaching may be improved, and the results of the experiments described here provide a means to that end.

Bibliography

Anderson, S. & Port, R. (1994). Evidence for syllable structure, stress and juncture from segmental durations. *Journal of Phonetics*, **22**, 283-315.

Bagemihl, B. (1991). Syllable structure in Bella Coola. *Linguistic Inquiry*, **22**,589-646.

Balasubramanian, T. (1980). Timing in Tamil. *Journal of Phonetics*, **8**, 449-467.

Balasubramanian, T. (1981). Duration of vowels in Tamil. *Journal of Phonetics*, **9**, 151-161.

Beaudoin, M. (1989). L'interaction des représentations orthographiques et phonologiques durant la lecture. In C. Ouellon (Eds.), *La description des langues naturelles en vue d'applications linguistiques* (179-186). Ste-Foy: ICRB.

Beaudoin, M. (1991). *L'organisation de la structure phonologique chez le bilingue*. Master's thesis, Université Laval.

Beaudoin, M. (1994). Différences de syllabation chez les franco-Albertains-es. Unpublished manuscript.

Beaudoin, M. (1995). La perception visuelle et auditive de la coupure syllabique. In L. Godbout (Ed.), Le savoir en tête (73-82). Edmonton: ACFAS-Alberta.

Bell, A. & Hooper, J.B. (1978). Issues and evidence in syllable phonology. In Bell, A. & Hooper, J.B. *Syllables and Segments*, Amsterdam: North-Holland, 3-22.

Benguerel, A.-P. & Ukrainetz McFadden, T. (1989). The effect of coarticulation on the role of transitions in vowel perception. *Phonetica*, **46**, 80-96.

Bertoncini, J. & Mehler, J. (1981). Syllables as units in infant speech perception. *Infant Behavior and Development*, **4**, 247-260.

Best, C. T., McRoberts, G.W. & Sithole, N.M. (1988). Examination of Perceptual Reorganization for Nonnative Speech Contrasts: Zulu Click Discrimination by English-Speaking Adults and Infants. *Journal of Experimental Psychology: Human Perception and Performance*, **14** (3), 345-360.

Border, G.J. & Harris, K.S. (1980). *Speech Science Primer*. Baltimore: Williams & Wilkins.

Boucher, V. (1988). A parameter of syllabification for VstopV and relative-timing invariance. *Journal of Phonetics*, **16**, 299-326.

Bowey, J.A. (1993). Orthographic rime priming. *The Quaterly Journal of Experimental Psychology*, **46A** (2), 247-271.

Brière, E. , Campbell, R., & Soemarmo, N. (1968). A Need for the Syllable in Contrastive Analysis. *Journal of Verbal Learning and Verbal Behavior*, **7**, 384-389.

Brière, E. (1966). An investigation of phonological interference. *Language*, **42** (4), 768-796.

Bhushan, V. (1978). *Les méthodes en statistique*. Ste-Foy: Presses de l'Université Laval.

Campbell, W. & Isard, S. (1991). Segment durations in a syllable frame. *Journal of Phonetics*, **19**, 37-47.

Clements, G.N. & Keyser, S.J. (1983). *CV Phonology: a generative theory of the syllable*. Cambridge: M.I.T. Press.

Commissioner of Official Languages of Canada (1990). Annual Report 1990. Ottawa.

Crompton, A. (1980). Timing patterns in French. *Phonetica*, **37**, 205-234.

Crystal, D. (1992). *An Encyclopedic Dictionary of Language and Languages*. West Drayton: Penguin Books.

Crystal, T. & House, A. (1988). The duration of American-English vowels: an overview. *Journal of Phonetics*, **16**, 263-284.

Crystal, T. & House, A. (1990). Articulation rate and the duration of syllables and stress groups in connected speech. *Journal of the Acoustical Society of America*, **88** (1), 101-112.

Cutler, A., Mehler, J., Norris, D., & Seguí, J. (1986). The syllable's differing role in the segmentation of French and English. *Journal of Memory and Language*, **25**, 385-400.

Cutler, A., Mehler, J., Norris, D., & Seguí, J. (1987). Phoneme identification and the lexicon. *Cognitive Psychology*, **19**, 141-177.

Cutler, A., Mehler, J., Norris, D., & Seguí, J. (1992). The monolingual nature of speech segmentation by bilinguals. *Cognitive Psychology*, **24**, 381-410.

Cutler, A. & Otake, T. (1994). Mora or phoneme? Further evidence for language-specific listening. *Journal of Memory and Language*, **33**, 824-844.

Davis, S. & Van Summers, W. (1989). Vowel length and closure duration in word-medial VC sequences. *Journal of Phonetics*, **17**, 339-353.

De Jong, D. (1993). Sociophonological aspects of Montreal French liaison. In Ashby, W.J., Mithun, M, Perissinotto, G, & Raposo, E. *Linguistic Perspectives on the Romance Languages*. Philadelphia: Benjamins.

De Jong, K, Bechkman, M.E., & Edwards, J. (1993). The interplay between prosodic structure and coarticulation. *Language and Speech*, **36** (2,3), 197-212.

Delattre, P. (1940). Tendances de coupe syllabique en français. *Publications of the Modern Language Association*, **55**(2), 579-595.

Delattre, P. (1944a). La syllabation ouverte par la méthode compensatrice. *The French Review*, **17** (4), 371-376.

Delattre, P. (1944b). L'aperture et la syllabation phonétique. *The French Review*, **17** (5), 281-285.

Delattre, P. (1981). *Studies in Comparative Phonetics: English, German, Spanish and French*. Heidelberg: Gross.

Delattre, P. & Olsen, C. (1969). Syllable features and phonic impression in English, German, French and Spanish. *Lingua*, **22**, 160-175.

Dell, F. (1995). Consonant clusters and phonological syllables in French. *Lingua*, **95**, 5-26.

Derwing, B. (1992). A 'pause-break' task for eliciting syllable boundary judgments from literate and illiterate speakers: Preliminary results for five diverse languages. *Language and Speech*, **35** (1-2), 219-235.

Derwing, B., Dow, M., & Nearey, T. (1987). Experimental evidence for phonological units. *Proceedings of the Eleventh International Congress of Phonetic Sciences*, 249-252.

Derwing, B., Dow, M., & Nearey, T. (1988). Experimenting with syllable structure. In J. Power & K. De Jong (Ed.), *ESCOL'88*, (pp. 83-94). Ohio State university.

Derwing, B. & Nearey, T. (1991). The 'vowel stickiness' phenomenon: Three experimental sources of evidence. In Proceedings of the Twelfth International Congress of Phonetic Sciences. Aix-en Provence, France.

Derwing, B., Parkinson, D., & Beinert, R. (1994). Experimental investigation of Arabic syllable structure. *Perspectives on Arabic Linguistics VII*. Amsterdam: Benjamins.

Derwing, B., Yoon, Y. B., & Cho, S. W. (1993). The organization of the Korean syllable: experimental evidence. *Japanese/Korean Linguistics*, **2**, 223-238.

Dorais, L.-J. (1975). *Inuit Uqausingit*. Québec: Association Inuksuitiit Katimajiit.

Edwards, J. & Beckman, M. (1988). Articulatory timing and the prosodic interpretation of syllable duration. *Phonetica*, **45**, 156-174.

Eliasson, S. (1984). Toward a theory of contrastive phonology. In Eliasson, S. *Theoretical Issues in Contrastive Phonology*, Heidelberg: Gross, 7-26.

Fant, G., Kruckenberg, A., & Nord, L. (1991). Durational correlates of stress in Swedish, French and English. *Journal of Phonetics*, **19**, 351-365.

Fintoft, K. (1961). The duration of some Norwegian speech sounds. *Phonetica*, **7**,19-39.

Flege, J.E. (1994). Second-language speech learning: theory, findings, and problems. In W. Strange (Ed.), Speech Perception and Linguistic Experience: Theoretical and Methodological Issues. Timonium, MD: York Press.

Fletcher, J. (1991). Rhythm and final lengthening in French. *Journal of Phonetics*, **19**, 193-212.

Fourakis, M. & Monahan, C. (1988). Effects of metrical foot structure on syllable timing. *Language and Speech*, **31**, 283-301.

Fowler, C.A. (1980). Coarticulation and theories of extrinsic timing. *Journal of Phonetics*, **8**, 113-133.

Fowler, C.A. (1981). A relationship between coarticulation and compensatory shortening. *Phonetica*, **38**, 35-50.

Fowler, C.A. (1990). Comments on the contributions by Pierrehumbert and Nearey. *Journal of Phonetics*, **18**, 425-434.

Fowler, C.A. (1992). Vowel duration and closure duration in voiced and unvoiced stops: there are no contrast effects here. *Journal of Phonetics*, **20**, 143-165.

Fox, R. (1989). Dynamic information in the identification and discrimination of vowels. *Phonetica*, **46**, 97-116.

Gay, T. (1978). Articulatory units: segments or syllables? In Bell, A.& Hooper, J.B. *Syllables and Segments*. Amsterdam: North-Holland, 212-131.

Gendron, J.-D. (1966). *Tendances phonétiques du français parlé au Canada*. Québec: Presses de l'Université Laval.

Giannini, A. (1987). On the relationship between coartuculatory effect of lip rounding and syllable boundary in French. *Proceedings of the 11th International Congress of Phonetic Sciences* Tallinn, Estonia. 299-302.

Gibson, E.J. & Levin, H. (1985). *The psychology of Reading*. Cambridge: M.I.T. Press.

Hamers, J. F. & Blanc, M. (1989). *Bilinguality and bilingualism.* Cambridge University Press: New-York.

Hammarberg, R. (1982). On redefining coarticulation. *Journal of Phonetics*, **10**, 123-137.

Hankamer, J., Lahiri, A., & Koreman, J. (1989). Perception of consonant length: voiceless stops in Turkish and Bengali. *Journal of Phonetics*, **17**, 283-298.

Healy, A.F. & Cutting, J.E. (1976). Units of speech perception: phoneme and syllable. *Journal of Verbal Learning and Verbal Behavior*, **15**, 73-83.

Hoequist, C. Jr. (1983). Syllable duration in stress-, syllable- and mora-timed languages. *Phonetica*, **40**, 203-237.

Homma, Y. (1981). Durational relationship between Japanese stops and vowels.*Journal of Phonetics*, **9**, 273-281.

Huang, H.S. & Hanley, J.R. (1994) Phonological awareness and visual skills in learning to read Chinese and English. *Cognition*, **54**, 73-98.

Huot, F.-D. (1978). *Difficultés phonétiques de l'acquisition du français langue seconde*. Québec: I.C.R.B.

Ingram, D. (1978). The role of the syllable in phonological development. In Bell, A. & Hooper, J.B. *Syllables and Segments*. Amsterdam: North-Holland, 143-155.

Jusczyk, P., Kennedy, L. & Jusczyk, A.M. (1995). Young infants' retention of information about syllables. *Infant Behavior and Development*, **18**, 27-41.

Kahn, D. (1976). *Syllable-Based Generalizations in English Phonology*. Bloomington: Indiana University Linguistics Club.

Kirtley, C., Bryant, P., MacLean, M., & Bradley, L. (1989). Rhyme, rime, and the onset of reading. *Journal of Experimental Child Psychology*, **48**, 224-245.

Klatt, D. (1976). Linguistic use of segmental duration in English: acoustic and perceptual evidence. *Journal of the Acoustical Society of America*, **59** (5), 1208-1221.

Kluender, K., Diehl, R., & Wright, B. (1988). Vowel-length differences before voiced and voiceless consonants: an auditory explanation. *Journal of Phonetics*, **16**, 153-169.

Kohler, K.J. (1981). Contrastive phonology and the acquistion of phonetic skills. *Phonetica*, **38**, 231-226.

Kolinsky, R., Morais, J., & Cluytens, M. (1995). Intermediate representation in spoken word recognition: evidence from word illusions. *Journal of Memory and Language*, **34**, 19-40.

Laeufer, C. (1991). Syllabification and resyllabification in French. In Wanner, D. & Kibbee, D.A. *New Analyses in Romance Linguistics*. Philadelphia: Benjamins, 19-36.

Laeufer, C. (1992). Patterns of voicing-conditionned vowel duration in French and English. *Journal of Phonetics*, **20**, 411-440.

Lahiri, A. & Hankamer, J. (1988). The timing of geminate consonants. *Journal of Phonetics*, **16**, 327-338.

Laks, B. (1995). A connectionist account of French syllabification. *Lingua*, **95**, 51-76.

Lee, K.-F., Hon, H.-W., & Reddy, R. (1990). An overview of the Sphinx speech recognition system. In Waibel, A. & Lee, K.-F. *Readings in Speech Recognition*. San Mateo: Morgan Kaufman.

Lehiste, I. (1978). The syllable as a structural unit in Estonian. In Bell, A. & Hooper, J.B. *Syllables and Segments*. Amsterdam: North-Holland, 73-83.

Levitt, A., Healy, A.F., & Frendrich, D.W. (1991). Syllable-internal structure and the sonority hierarchy: differential evidence from lexical decision, naming, and reading. *Journal of Psycholinguistic Research*, **20** (4), 336-363.

Liberman, I., Shankweiler, D., Fischer, F., & Carter, B. (1974). Explicit syllable and phoneme segmentation in the young child. *Journal of Experimental Child Psychology*, **18**, 201-212.

Lisker, L. (1978). Segment duration, voicing, and the syllable. In Bell, A. & Hooper, J.B. *Syllables and Segments*. Amsterdam: North-Holland, 133-140.

Lowenstramm, J. (1981). On the maximal cluster approach to syllable structure. *Linguistic Inquiry*, **12** (4), 575-604.

Maddieson, I. (1985). Phonetic cues to syllabification. In Fromkin, V.A. *Phonetic Linguistics*. San Diego: Academic Press, 203-221.

Maeda, S. (1991). On articulatory and acoustic variabilities. *Journal of Phonetics*, **19**, 321-331.

Malmberg, B. (1967). The phonetic basis for syllable division. *Studia linguistica*, **9**, 80-87.

Manuel, S. (1988). The role of contrast in limiting vowel-to-vowel coarticulation in different languages. *Journal of the Acoustical Society of America*, **88** (3), 1286-1298.

Marouby-Terriou, G. & Denhière, G. (1994). L'identification d'items mono- et bisyllabiques par des enfants apprentis lecteurs. Effet de la structure de la langue et de la méthode d'apprentissage. *Enfance*, **4**, 345-365.

McGurk, H. & MacDonald, J. (1976). Hearing lips and seeing voices. *Nature*, **264**, 746-748.

McKay, G. (1980). Medial stop gemination in Rembarrnga: a spectrographic study.*Journal of Phonetics*, **8**, 343-352.

McNeill, D. & Lindig, K. (1973). The perceptual reality of phonemes, syllables,words, and sentences. *Journal of Verbal Learning and Verbal Behavior*, **12**, 419-430.

Mehler, J., Dommergues, J., Frauenfelder, U., & Seguí J. (1981). The syllable's role in speech segmentation. *Journal of Verbal Learning and Verbal Behavior*, **20**, 298-305.

Mermelstein, P. (1975). A phonetic-context controlled strategy for segmentation and phonetic labelling of speech. *I.E.E.E. Transactions on Acoustics, Speech and Signal Processing*, **ASSP-23** (1), 79-82.

Meyer, A. (1990). The time course of phonological encoding in language production: the encoding of successive syllables of a word. *Journal of Memory and Language*, **29**, 524-545.

Morais, J., Cary, L., Alegria, J., & Bertelson, P. (1979). Does awareness of speech as a sequence of phones arise spontaneously? *Cognition*, **7**, 323-331.

Munhall, K., Fowler, C., Hawkins, S., & Saltzman, E. (1992). "Compensatory shortening" in monosyllables of spoken English. *Journal of Phonetics*, **20**, 225-239.

Nearey, T. (1990). The segment as a unit of speech perception. *Journal of Phonetics*, **18**, 347-373.

Norris, D. & Cutler, A. (1988). The relative accessibility of phonemes and syllables. *Perception & Psychophysics*, **43** (6), 541-550.

Noske, R. (1982). Syllabification and syllable changing rules in French. In van der Hulst, H. & Smith, N. *The Structure of Phonological Representations* (part 2). Dordrecht: Foris Publications, 257-310.

O'Connor, J.D. & Trim, J.L.M. (1953). Vowel, consonant, and syllable — a phonological definition. *Word*, **9** (2), 103-122.

O'Shaughnessy, D. (1981). A study of French vowel and consonant durations. *Journal of Phonetics*, **9**, 385-406.

Ohala, J. (1990). There is no interface between phonology and phonetics: a personal view. *Journal of Phonetics*, **18**, 153-171.

Ohala, J. & Kawasaki, H. (1984). Prosodic phonology and phonetics. *Phonology Yearbook*, **1**, 113-127.

Perfetti, C. & Zhang, S. (1991). Phonological processes in reading Chinese characters. *Journal of Experimental Psychology: Learning, Memory and Cognition*, **17** (4), 633-643.

Perfetti, C. & Zhang, S. (1995). Very early phonological activation in Chinese reading. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, **21** (1),24-33.

Peterson, G.E. & Lehiste, I. (1960). Duration of syllable nuclei in English. *Journal of the Acoustical Society of America*, **33**, 693-703.

Pike, K. (1945). *The Intonation of American English*. Ann Arbor: University of Michigan Press.

Pointon, G.E. (1980). Is Spanish really syllable-timed? *Journal of Phonetics*, **8**, 293-304.

Port, R., Al-Ani, S., & Maeda, S. (1980). Temporal compensation and universal phonetics. *Phonetica*, **37**, 235-252.

Pulgram, E. (1970). *Syllable, Word, Nexus, Cursus*. The Hague: Mouton.

Quené, H. (1992). Durational cues for word segmentation in Dutch. *Journal of Phonetics*, **20**, 331-350.

Raphael, L. & Dorman, M. (1980). Silence as a cue to the perception of syllable-initial and syllable-final stop consonants. *Journal of Phonetics*, **8**, 269-275.

Recasens, D. (1991). An electropalatographic and acoustic study of consonant-to-vowel coarticulation. *Journal of Phonetics*, **19**, 177-192.

Repp, B. (1978). Perceptual integration and differentiation of spectral cues for intervocalic stop consonants. *Perception & Psychophysics*, **24** (5), 471-485.

Rosetti, A. (1961). Sur le problème de la syllabe: réponse à M.B. Hala. *Phonetica*, **7**, 109-113.

Sato, C. J. (1984). Phonological processes in second language acquisition: Another look at interlanguage syllable structure. *Language Learning*, **34** (4), 43-57.

Sato, Y. (1993). The durations of sllable-final nasals and the mora hypothesis in Japanese. *Phonetica*, **50**, 44-67.

Schouten, M.E.H. & Pols, L.C.W. (1979a). CV- and CV-transitions: a spectral study of coarticulation-Part II. *Journal of Phonetics*, **7**, 205-224.

Schouten, M.E.H. & Pols, L.C.W. (1979b). Vowel segments in consonantal contexts: a spectral study of coarticulation-Part I. *Journal of Phonetics*, **7**, 1-23.

Scott, D. R., Isard, S. D., & de Boysson-Bardies, B. (1985). Perceptual isochrony in English and in French. *Journal of Phonetics*, **13**,: 155-162.

Sebastián-Gallés, N., Dupoux, E., Seguí & Mehler, J. (1992). Contrasting syllable effects in Catalan and Spanish. *Journal of Memory and Language*, **31**, 18-32.

Seguí, J. (1982). The syllable: a basic perceptual unit in speech processing? In Bouma, H. & Bouwhuis, D.G. *Attention and Performance X*. London: Lawrence Erlbaum Associates, 165-181.

Seidenberg, M. (1985). The time course of phonological code activation in two writing systems. *Cognition*, **19**, 1-30.

Selkirk, E. (1982). The syllable. In Van Der Hulst, H. & Smith, N. *The Structure of Phonological Representation*. Dordrecht: Foris, 337-383.

Stemberger, J. & Treiman, R. (1986). The internal structure of word-initial consonant clusters. *Journal of Memory and Language*, **25**, 163-180.

Suomi, K. (1987). On spectral coarticulation in stop-vowel-stop syllables:implications for automatic speech recognition. *Journal of Phonetics*, **15**, 85-100.

Tan, L.H., Hoosain, R., & Peng, D.L. (1995) Role of early presemantic phonological code in Chinese character identification. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, **21** (1), 43-54.

Tarone, E. (1980). Some Influences on the syllable structure of interlanguage phonology. *International Review of Applied Linguistics*, **18**, 139-152.

Touati, P. (1987). *Structures prosodiques du suédois et du français*. Lund: Lund University Press.

Trammell, R. (1993). English ambisyllabic consonants and half-closed syllables in language teaching. *Language Learning*, **43** (2), 195-238.

Treiman, R. (1983). The structure of spoken syllables: evidence from novel word games. *Cognition*, **15**, 49-74.

Treiman, R. (1985) Onset and rimes as units of spoken syllables: evidence from children. *Journal of Experimental Child Psychology*, **39**, 161-181.

Treiman, R. (1986). The division between onsets and rimes in English syllables. *Journal of Memory and Language*, **25**, 476-491.

Treiman, R. (1988). Distributional constraints and syllable structure in English. *Journal of Phonetics*, **16**, 221-229.

Treiman, R. & Breaux, A. (1982). Common phoneme and overall similarity relations among spoken syllables: Their use by children and adults. *Journal of Psycholinguistic Research*, **11**(6), 569-598.

Treiman, R. & Danis, C. (1988a). Syllabification of intervocalic consonants. *Journal of Memory and Language*, **27**, 87-104.

Treiman, R. & Danis, C. (1988b). Short-term memory errors for spoken syllables are affected by the linguistic structure of the syllables. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, **14** (1), 145-152.

Treiman, R., Gross, J., & Cwikiel-Glavin, A. (1992). The syllabification of /s/ clusters in English. *Journal of Phonetics*, **20**, 383-402.

Treiman, R., Straub, K., & Lavery, P. (1994). Syllabification of bisyllabic nonwords: evidence from short-term memory errors. *Language and Speech*, **37** (1), 45-60.

Treiman, R. & Zukowski, A. (1990). Toward an understanding of English syllabification. *Journal of Memory and Language*, **29**, 66-85.

Tye-Murray, N. & Woodworth, G. (1989). The influence of final-syllable position on the vowel and word duration of deaf talkers. *Journal of the Acoustical Society of America*, **85** (1), 313-321.

Van Lancker, D., Kreiman, J., & Bolinger, D. (1988). Anticipatory lengthening. *Journal of Phonetics*, **16**, 339-347.

Vellutino, F. & Scanlon, D. (1987). Phonological coding, phonological awareness,and reading ability: evidence from a longitudinal and experimental study. *Merrill-Palmer Quarterly*, **33** (3), 321-363.

Vennemann, T. (1988). *Preference Laws for Syllable Structure*. Berlin: Mouton de Gruyter.

Waibel, A. & Lee, K.-F. (1990). *Readings in Speech Recognition*. San Mateo: Morgan Kaufman.

Walker, D.C. (1984). *The pronunciation of Canadian French*. Ottawa: University of Ottawa Press.

Walley, A., Smith, L., & Jusczyk, P. (1986). The role of phonemes and syllables in the perceived similarity of speech sounds for children. *Memory & Cognition*, **14** (3), 220-229.

Wang, H. & Derwing, B. (1993). Is Taiwanese a 'body' language? *Journal of Chinese Linguistics*.

Wardrip-Fruin, C. (1982). On the status of temporal cues to phonetic categories:preceding vowel duration as a cue to voicing in final stop consonants. *Journal of the Acoustical Society of America*, **71** (1), 187-195.

Wenk, B. (1985). Speech rhythms in second language acquisition. *Language and Speech*, **28** (2), 127-172.

Wenk, B. & Wioland, F. (1982). Is French really syllable-timed? *Journal of Phonetics*, **10**, 193-216.

Wijnen, F. (1988). Spontaneous word fragmentations in children: evidence for the syllable as a unit in speech production. *Journal of Phonetics*, **16**, 187-202.

Wilbur, R. & Allen, G. (1991). Perceptual evidence against internal structure in American Sign Language syllables. *Language and Speech*, **34** (1), 27-46.

Wimmer, H., Landerl, K., Linortner, R., & Hummer, P. (1991). The relationship of phonemic awareness to reading acquisition: more consequence than precondition but still important. *Cognition*, **40**, 219-249.

Wioland, F. (1985). *Les structures syllabiques du français*. Genève: Slatkine-Champion.

Wise, B., Olson, R., & Treiman, R. (1990). Subsyllabic units in computerized reading instruction: onset-rime vs. postvowel segmentation. *Journal of Experimental Child Psychology*, **49**, 1-19.

Yaniv, I., Meyer, D., Gordon, P., Huff, C., & Sevald, C. (1990). Vowel similarity, connectionist models, and syllable structure in motor programming of speech. *Journal of Memory and Language*, **29**, 1-26.

Zec, D. (1994). *Sonority Constraints on Prosodic Structure*. New York: Garland Publishing.

Ziegler, W., Hartmann, E., & Hoole, P. (1993). Syllable timing in dysarthria. *Journal of Speech and Hearing Research*, **36**, 683-693.

Appendix A: instructions for the experiments presented in the thesis

Instructions for experiment one

[1st window]

Bonjour et merci de bien vouloir participer à cette recherche. Une fois que nous aurons saisi quelques informations personnelles, nous débuterons les tests proprement dits. Tout au long de cette expérience, vous devrez utiliser la souris de l'ordinateur. Faites attention de ne cliquer qu'UNE SEULE FOIS lorsque vous avez fait un choix (soyez patient-e!!!).

Par ailleurs, vous n'avez pas à travailler très rapidement, cependant, il vous sera plus facile de faire vos choix spontanément et rapidement. Il n'y a pas de bonnes ou de mauvaises réponses dans ces tests: nous nous intéressons à VOS CHOIX!

Encore une fois, merci de votre participation, et voici quelques questions personnelles.

(cliquez une fois lorsque vous avez lu ce texte)

[2nd window — audio version]

Dans ce test, vous entendrez un mot et les différentes façons de découper ce mot. Par exemple, vous pourriez entendre "genou", puis "a) ge-nou", "b) gen-nou" et "c) gen-ou". Cliquez sur le bouton qui représente selon vous votre façon de découper ce mot.

Voici un exemple...

(cliquez une fois lorsque vous êtes prêt pour l'exemple)

[2nd window — audio-visual version]

Dans ce test, vous entendrez un mot et les différentes façons de découper ce mot tout en voyant ces choix dans les boutons à l'écran. Par exemple, vous pourriez entendre "genou", puis "a) ge-nou", "b) gen-nou" et "c) gen-ou" et vous pourrez lire ce mot tel quel. Cliquez sur le bouton qui représente selon vous votre façon de découper ce mot.

Voici un exemple...

(cliquez une fois lorsque vous êtes prêt pour l'exemple)

[2nd window — visual version]

Dans ce test, vous entendrez un mot et vous verrez dans les boutons au centre de l'écran différentes façons de découper le mot. Par exemple, vous pourriez entendre "genou" et vous pourriez lire "ge-nou" dans le bouton a), "gen-nou" dans le bouton b) et "gen-ou" dans le bouton c). Cliquez sur le bouton qui représente selon vous votre façon de découper ce mot.

Voici un exemple...

(cliquez une fois lorsque vous êtes prêt pour l'exemple)

[3rd window]

Comme vous le voyez, c'est très simple.

(cliquez quand vous êtes prêt-e à commencer l'expérience)

Instructions for experiment two (French version)

[1st window]

Bonjour et merci de bien vouloir participer à cette recherche. Une fois que nous aurons saisi quelques informations personnelles, nous

débuterons les tests proprement dits. Tout au long de cette expérience, vous devrez utiliser la souris de l'ordinateur. Faites attention de ne cliquer qu'UNE SEULE FOIS lorsque vous avez fait un choix (soyez patient-e!!!).

Par ailleurs, vous n'avez pas à travailler très rapidement, cependant, il vous sera plus facile de faire vos choix spontanément et rapidement. Il n'y a pas de bonnes ou de mauvaises réponses dans ces tests: nous nous intéressons à VOS CHOIX!

Encore une fois, merci de votre participation, et voici quelques questions personnelles.

(cliquez une fois lorsque vous avez lu ce texte)

[2nd window — French stimuli version]

Dans ce test, vous entendrez un mot français et vous verrez dans les boutons au centre de l'écran différentes façons de découper le mot. Par exemple, vous pourriez entendre "genou" et vous pourriez lire "ge-nou" dans le bouton a), "gen-nou" dans le bouton b) et "gen-ou" dans le bouton c). Cliquez sur le bouton qui représente selon vous votre façon de découper ce mot.

Voici un exemple...

(cliquez une fois lorsque vous êtes prêt pour l'exemple)

[2nd window — English stimuli version]

Dans ce test, vous entendrez un mot anglais et vous verrez dans les boutons au centre de l'écran différentes façons de découper le mot. Par exemple, vous pourriez entendre "genou" et vous pourriez lire "ge-nou" dans le bouton a), "gen-nou" dans le bouton b) et "gen-ou" dans le bouton c). Cliquez sur le bouton qui représente selon vous votre façon de découper ce mot.

Voici un exemple...

(cliquez une fois lorsque vous êtes prêt pour l'exemple)

[3rd window]

Comme vous le voyez, c'est très simple.

(cliquez quand vous êtes prêt-e à commencer l'expérience)

Instructions for experiment two (English version)

[1st window]

Thank you for your participation. Once you have answered a few questions about yourself, we will begin the actual test. Throughout the experiment, you will have to use the computer mouse. When using the mouse, be careful to always click only once at any given time (Be patient!!!). This computer is slow and clicking twice in a row will confuse it.

You do not have to rush through this experiment. However, it might be easier to answer spontaneously and thus to not think about an answer twice. There are no good or bad answer: we are interested in your choices!

Once again, thank you for your participation. Here are a few questions on personal information.

(click once anywhere when you have read this)

[2nd window — French stimuli version]

In this test, you will hear a French word and you will see different boxes that show different ways to divide that word. For example, you might hear the word "genou" and see find "ge-nou" in the first box,

"gen-nou" in the second one, and "gen-ou" in the third box. Click on the box that shows the way you would divide that word. Note that the spelling of the words in the boxes might be modified as to show better the division.

Here is an example...

(Click once when you are ready to see an example)

[2nd window — English stimuli version]

In this test, you will hear a English word and you will see different boxes that show different ways to divide that word. For example, you might hear the word "money" and see find "mon-ey" in the first box, "mon-ney" in the second one, and "mo-ney" in the third box. Click on the box that shows the way you would divide that word. Note that the spelling of the words in the boxes might be modified as to show better the division.

Here is an example...

(Click once when you are ready to see an example)

[3rd window]

As you can see, it is very simple.

(Click once when you are ready to start the actual test)

Instructions for experiment three

[1st window]

Merci de votre collaboration. Nous allons maintenant commencer l'expérience. Tout au long de l'expérience, vous devrez utiliser la souris pour donner vos réponses. Lorsque vous donnez vos réponses,

ne cliquez qu'une seule fois au centre du carré. Cliquer deux fois va rendre l'ordinateur confus. Vous ne pouvez pas répéter un mot.

Vous n'avez pas à vous presser durant l'expérience. Cependant, il peut vous être plus facile de répondre spontanément. Il n'y a pas de bonnes ou de mauvaises réponses: nous nous intéressons à vos choix!

Encore une fois, merci de votre participation et l'expérience commence. (Cliquez une fois lorsque vous avez lu ce texte)

[2nd window]

Dans cette expérience, vous allez entendre des mots français et vous verrez différentes façons de diviser ces mots dans des boîtes à l'écran. Par exemple, vous pourriez entendre le mot "lavé" et vous pourriez voir dans la première boîte "lav-é", "la-vé" dans la deuxième boîte et "lav-vé" dans la troisième boîte. Cliquez dans la boîte qui contient votre façon préférée de diviser ce mot. Veuillez noter que l'épélation du mot a été modifiée pour mieux montrer les découpages possibles. Rappelez-vous que vous découpez les mots comme VOUS les préférez, et non comme la personne les prononce.

Cliquez une fois lorsque vous êtes prêt-e pour en exemple

[3rd window]

Comme vous le voyez, c'est très simple.

(cliquez quand vous êtes prêt-e à commencer l'expérience)

Appendix B: Manuscript

Différences de syllabation chez les franco-Albertains-es

Résumé:

La structure de la syllabe française est dite généralement ouverte (c'est-à-dire que la plupart des syllabes n'ont pas de consonne prononcée en finale) pour les populations européennes et québécoises. Des observations systématiques m'ont permis de remarquer que les choses sont quelque peu différentes chez les franco-Albertains bilingues et unilingues. En effet, les franco-Albertains unilingues (qui sont dans notre étude âgés) se fient essentiellement à l'orthographe pour déterminer les coupures syllabiques. Ce facteur est sans doute lié aux techniques d'alphabétisation alors utilisés. Les franco-Albertains bilingues (plus jeunes) se fient aussi à l'orthographe pour déterminer les coupures syllabiques mais dans une moins large mesure. De plus, la syllabation ouverte est proportionnellement moins fréquente que ce à quoi on s'attend normalement. Ces syllabations sont remplacées par des structures ambisyllabiques et fermées. Ce phénomène pourrait être important dans l'enseignement du français dans l'Ouest puisque la structure syllabique a une grande importance sur la prononciation des phonèmes français. Par ailleurs, ces résultats sont mis en contraste avec les résultats aux mêmes tests pour des anglophones apprenant le français en milieu Albertain. Leurs résultats sont similaires à ceux obtenus pour les francophones bilingues mais la proportion de syllabes ouvertes est significativement moindre pour les apprenants de langue seconde que pour les francophones bilingues.

La syllabe est une structure supra-segmentale d'une longueur plutôt limitée. La structure de la syllabe permet une hiérarchie au sein des phonèmes. Elle est définie formellement comme étant un sommet d'énergie facultativement entouré de consonnes. Les composantes de la syllabe sont l'attaque, le noyau et la coda. Toute syllabe a un noyau qui est habituellement une voyelle. Cependant, l'attaque et la coda sont facultatives. Traditionnellement, on appelle une syllabe sans coda une syllabe ouverte et on appelle une syllabe avec coda une syllabe fermée. Lorsque la consonne qui constitue la coda d'une syllabe se trouve aussi à être l'attaque de la syllabe suivante comme dans le mot "pommier", on dit alors que la consonne, et par extension la première syllabe, est ambisyllabique.

Pierre Delattre a dit en 1940 que 80% des syllabes françaises sont ouvertes et que 20% sont fermées, sans que l'on puisse prévoir lesquelles seront ouvertes ou fermées. Depuis ce temps, presqu'aucune étude n'a porté sur la structure de la syllabe française. Or, une série d'études pilotes me porte à croire que cette règle du 80/20 est imprécise. L'étude pilote que je présenterai aujourd'hui démontrera malgré la taille de l'échantillon que la règle du 80/20 est imprécise pour les francophones unilingues du Québec, qu'elle est fausse pour les francophones unilingues de l'Alberta et finalement que la structure syllabique du français est influencée par l'apprentissage d'une autre langue (ici l'anglais). Par ailleurs, je démontrerai qu'il est possible d'apprendre la structure syllabique d'une langue seconde.

L'étude de la structure syllabique est importante parce qu'elle est directement liée à la prononciation des voyelles. En effet, les voyelles sont phonétiquement différentes en syllabe ouverte et en syllabe fermée. Par exemple, le /i/ dans "lit" est différent du /I/ dans "Line" puisqu'en franco-canadien, il y a relâchement des voyelles hautes en syllabe fermées. Il faut noter que le relâchement des voyelles hautes peut entraîner une confusion entre certaines de ces voyelles. Par ailleurs, il existe plusieurs dialectes où les voyelles /e/ se prononce

seulement en syllabe ouverte alors que le /ɛ/ ne se retrouve qu'en syllabe fermée. Il en est de même pour la paire de voyelles /o/ et /ɔ/ et pour la paire /ɔ/ et /œ/ de façon encore plus marquée. S'il est clair que la structure syllabique chez une personne influence sa façon de parler, il est évident que la perception qu'en auront ses interlocuteurs sera indirectement influencée.

Notons en passant que la structure de la syllabe anglaise est étudiée par bon nombre de chercheurs (cf. Derwing, 1992; Treiman, 1988; Brière, Campbell, & Soemarmo,1968 entre autres). En général, il semble se dégager la conclusion que la syllabe est fortement influencée par la structure de l'accent tonique et qu'ainsi, sous l'accent tonique, la syllabe comportera autant de consonnes que possible de part et d'autre du noyau. Il faut noter aussi que l'anglais est une des langues exceptionnelles qui peuvent avoir des consonnes pour noyau syllabique. Cette structure accentuelle/syllabique est importante pour les apprenants anglophones du français L2 puisqu'ils tentent toujours de donner un accent tonique au français qui n'en a virtuellement pas. Ceci influence évidemment la prononciation de ces apprenants. Or en leur enseignant la structure syllabique du français et en éliminant leur accent tonique, on élimine une partie importante de leurs erreurs de prononciation.

La présente recherche tente de mieux connaître la structure syllabique de certains dialectes français au Canada. Pour connaître la structure syllabique, j'ai utilisé une méthodologie rendue populaire par Bruce Derwing de l'Université d'Alberta appelée "coupure de pause" (pause break). Elle consiste à présenter un mot auditivement au sujet et à lui demander d'indiquer où il ferait une coupure s'il devait faire une pause. On lui donne trois choix de réponses dont l'ordre varie de façon aléatoire.

Expérience

Mon hypothèse théorique de départ était que la structure syllabique des populations Canadiennes-françaises vont varier avec le

degré d'exposition à une autre langue dont la structure syllabique diffère de celle du français. En cours de route, j'ai fait des observations qui soulèvent d'autres hypothèses. La première est que la structure de la syllabe n'est pas identique dans tous les dialectes d'une même langue. La seconde hypothèse est que la structure syllabique d'une L2 peut être acquise par l'apprenant.

Sujets: Mon étude impliquait 5 groupes différents sur le lieu d'origine, la langue maternelle et la bilingualité. Le groupe 1 était composé de 3 francophones unilingues de la ville de Québec. Bien qu'ils aient tous été exposés à l'anglais, aucun ne serait en mesure de maintenir la moindre conversation dans une autre langue que le français. Le groupe 2 est composé de 3 francophones unilingues de l'Alberta. Tous sont nés au Québec mais ont passé plus de 40 ans de leur vie en Alberta. Bien qu'ils aient tous été exposés à l'anglais, aucun ne serait en mesure de maintenir la moindre conversation dans une autre langue que le français. Le groupe 3 est composé de 6 francophones bilingues du Québec. Le groupe 4 est composé de 3 francophones bilingues de l'Alberta ou de la Saskatchewan. Le groupe 5 est composé de 7 anglophones bilingues. Tous avaient les connaissances suffisantes en français pour pouvoir poursuivre des études universitaires en français. Ils provenaient de l'Ouest Canadien, à l'exception d'un qui venait de l'Ontario et d'un autre qui venait de l'Angleterre.

Une analyse post-hoc montre que certains des groupes étaient moins homogènes que souhaité. Les unilingues Albertains et les bilingues du Québec étaient homogènes ($\chi 2 = 9.106$, d.l. = 6, n.s. et $\chi 2 = 3.081$, d.l.=4, n.s. respectivement). Les unilingues du Québec étaient moins homogènes ($\chi 2 = 11.25$, d.l. = 4, $p > .05$). Les bilingues Albertains et les anglophones sont hétérogènes ($\chi 2 = 54.52$, d.l. = 15, $p > .01$ et $\chi 2 = 68.23$, d.l. = 18, $p > .01$ respectivement).

Corpus: La liste de mots utilisés comporte 40 mots bisyllabiques français courants dont la structure est CVCV. La consonne initiale et la première voyelle ne sont pas contrôlées. La consonne médiane est une

des 5 consonnes suivantes: /R/, /l/, /n/, /s/, /t/. De plus, j'ai tenu à contrôler le nombre de lettres utilisées à l'écrit pour représenter ces phonèmes. Ainsi, pour chacune des consonnes décrites ci-dessus, il y a 4 mots dont la consonne médiane est un singlet et 4 mots dont la consonne est un doublet.

Procédure: La liste, une fois distribuée aléatoirement est enregistrée par l'auteur dans un studio insonorisé. Les directives données au début de la bande comportent un exemple de la tâche à effectuer. Chaque mot est suivi de trois choix possibles de coupure syllabique. Ces choix sont aussi distribué aléatoirement. Les sujets indiquent leur choix sur une feuille qui leur est fournie. L'ensemble de l'expérience se fait dans un laboratoire de langue dont les modules sont isolés, sauf pour les sujets unilingues qui ont fait l'expérience chez eux avec l'assistance du chercheur. Tous ont pour directive de ne pas arrêter la bande sonore une fois l'expérience commencée. Leur tâche consiste à indiquer lequel des choix entendus représente à leur avis l'endroit où ils feraient une pause s'il le fallait.

Résultats

Les données concernant le type de découpage syllabique sont de façon évidente des données catégorielles (variable indépendante). La variable dépendante est le groupe d'appartenance des sujets. Les variables de contrôle sont le nombre de lettres pour représenter le phonème de chacun des mots et les phonèmes en cause.

Le graphique 1 illustre les pourcentages de syllabe selon le type de syllabe pour chacun des groupes de sujets. La différence entre ces groupes est significative ($\chi 2 = 43.50$, d.l. = 12, $p > .01$). Il y a deux différences importantes entre les groupes: a) plus le groupe a été exposé à l'anglais, moins ce groupe classifie les syllabes comme étant ouvertes (CV); b) plus le groupe a été exposé à l'anglais, plus ce groupe classifie les syllabes comme étant ambisyllabiques, sauf pour les anglophones. Mais plus important encore, les francophones bilingues et unilingues de l'Alberta syllabifient en général de façon

presqu'identique. Aussi, l'ensemble des francophones donnent moins de syllabes fermées que les anglophones.

Le nombre de lettres utilisées pour représenter les phonèmes peuvent influencer le découpage syllabique selon certains linguistes (Derwing, 1992; Treiman, 1983; 1988). Les résultats obtenus dans la présente étude confirment cette hypothèse: ($\chi 2 = 85.05$, d.l. = 3, $p > .01$). Ainsi, les phonèmes en singlet amènent presque seulement des syllabes ouvertes pour tous les groupes de francophones sauf pour /n/ dont je discuterai plus loin. Par ailleurs, la structure des syllabes amenées par les doublets varie grandement.

Les phonèmes n'amènent pas tous des réactions similaires (un test statistique du type "test H" serait ici souhaitable, mais aucun programme commercial ne le permet). D'abord, chez les francophones unilingues du Québec, toutes les consonnes en singlet sauf /n/ amènent presqu'uniquement des syllabes ouvertes. En doublet, /l/, /R/ et /t/ amènent presqu'uniquement des syllabes ouvertes. Cependant, /n/ en singlet et en doublet, et /s/ en doublet amènent un nombre important de syllabes ambisyllabiques et fermées. Ceci est étonnant, surtout pour le /n/ en singlet qui est la seule consonne en singlet à réagir ainsi.

Les unilingues de l'Alberta ont une structure syllabique similaire aux unilingues du Québec pour les consonnes en singlets, mais les consonnes en doublet amènent à peu près autant de syllabes ouvertes que de syllabes ambisyllabiques. Les bilingues de l'Alberta ont des résultats comparables à ceux des unilingues de l'Alberta.

Si les résultats des bilingues du Québec pour les consonnes en singlet sont similaires aux autres groupes, leurs résultats sont différents de tous les autres groupes pour les consonnes en doublets. En effet, /n/, /s/ et /l/ amènent plus de syllabes ambisyllabiques que de syllabes ouvertes. /t/ et /R/ en doublet ont aussi une proportion importante de syllabes ambisyllabiques mais dans une moindre mesure.

Les anglophones ont moins de syllabes ouvertes pour les consonnes en singlets et plus de syllabes fermées, sauf pour /s/ qui est presque toujours en syllabe ouverte et sauf pour /n/ qui fait toujours exception. Les consonnes en doublet sont comparables à celles des bilingues du Québec sauf pour le /s/ qui amène plus de syllabes ouvertes que de syllabes ambisyllabiques.

Discussion

La première conclusion à tirer de ces données est que les francophones qui deviennent exposés à l'anglais changent la structure syllabique de leur langue maternelle. La seconde conclusion est qu'il y a une certaine homogénéité dans la structure syllabique des francophones de l'Alberta, qu'ils soient unilingues ou bilingues. La troisième conclusion est que la structure syllabique d'une L2 peut s'apprendre. La quatrième conclusion est que le phonème /n/ fonctionne dans la syllabe de façon très particulière.

Pour les Québécois francophones unilingues, on observe qu'en général, le principe pédgogique de Delattre fonctionne. Cependant, lorsqu'on observe attentivement les données, on remarque rapidement qu'on trouve presqu'uniquement des syllabes ouvertes pour toutes les consonnes en singlet, sauf pour /n/. Même parmi les doublets, la majeure partie des consonnes amènent plus de 75% de syllabes ouvertes. Donc, règle générale, les syllabes non-finales des mots polysyllabiques en français québécois sont presque toujours ouvertes lorsque la consonne graphique qui la représente est en singlet. Si elles sont représentées graphiquement par des doublets les syllabes sont surtout ouvertes, sauf pour le /n/ et le /s/. Le /n/ constitue un problème particulier dont je parlerai plus tard.

Les francophones unilingues de l'Alberta (qui sont tous originaires du Québec) ont le même type de syllabification que les francophones unilingues du Québec sauf pour les phonèmes représentés par des doublets (et pour le /n/). Cette différence peut être attribuée au mode d'apprentissage de la lecture. En effet, à l'époque où

ces gens ont appris à lire, l'orthographe se faisait de façon syllabique alors que l'orthographe se fait maintenant lettre par lettre. Or, lorsqu'un mot comportait deux graphèmes consonnantiques identiques contiguës, la coupure syllabique était faite entre les deux. Des tests plus spécifiques pourraient révéler les structures réelles de la syllabe. Cependant, si les résultats étaient uniquement un artéfact, les résultats pour les doublets seraient beaucoup plus similaires aux résultats pour les singlets qu'ils ne le sont ici.

Les francophones bilingues de l'Alberta ont une structure syllabique très semblable à celle de leurs parents/grands-parents. Cette homogénéité apparente est réduite par le fait que le groupe des bilingues Albertains n'est pas homogène en soi. On peut ainsi conclure que certains des franco-Albertains bilingues ont en général maintenu relativement bien les structures syllabiques des générations précédentes. Ceci peut s'expliquer du fait que c'est d'eux qu'ils ont appris la langue. Il est aussi possible que le degré de bilingualité chez ces sujets ou leur âge d'apprentissage de L2 soit différent de celui des bilingues du Québec, facteurs qui n'ont pas été vérifiés ici. Il se peut aussi que le manque d'homogénéité au sein du groupe ait affecté les données au point de non-interprétabilité.

Les francophones bilingues du Québec syllabifient de façon intermédiaire entre les francophones unilingues du Québec et les anglophones syllabifiant des mots français. Ceci est relativement conforme à l'hypothèse du point milieu des bilingues proposée par Mack (1989).

Les anglophones syllabifient de façon très hétérogène. Il se peut que ceci soit causé par la diversité de leurs origines, mais je crois surtout que c'est causé par des différences d'acquisition de L2. Il me semble clair que, puisque certains des sujets syllabifient de façon similaire aux francophones unilingues du Québec, la syllabe de langue seconde peut être acquise, et ainsi, on peut croire qu'un enseignement

spécifique des méthodes de syllabation française pourrait augmenter la ressemblance avec la syllabation des francophones unilingues.

Par ailleurs, le phonème /n/ fait exception à la structure syllabique tant comme doublet que comme singlet. Cet état de fait n'ayant jamais été observé ne français auparavant, l'explication que je présente ici est hypothétique et reste à être vérifiée. Les voyelles peuvent être nasales, et puisque la nasalité des voyelles orales est plus élevée dans le français du Canada que dans le français Européen, il est fort possible que la consonne nasale ait une influence rétroactive et qu'ainsi, elle puisse être assimilée à la syllabe initiale du mot bisyllabique plus aisément que les autres consonnes. Il me faut remarquer que les consonnes nasales sont aussi les seules consonnes qui peuvent se retrouver dans la coda dans plusieurs langues asiatiques.

Conclusion

Somme toute, j'ai démontré que la structure syllabique en français du Canada varie selon la région et selon l'exposition à l'anglais comme L2. Elle est aussi influencée par le nombre de lettres utilisées pour écrire une consonne phonétique. J'ai cependant démontré que malgré une plus grande exposition à l'anglais, les jeunes franco-Albertains bilingues ont une structure syllabique semblable à celle de leurs parents ou grand-parents francophones unilingues. J'ai finalement démontré que certains phonèmes n'étaient pas syllabifiés comme les autres consonnes pour des raisons phonétiques. Il est important de se rappeler que la présente recherche est la première d'une longue série. La taille de l'échantillon est petite et il faut se garder de généraliser ces résultats trop rapidement. Entre autres, il faudrait que les études à venir impliquent plus de sujets et plus de stimuli. Il serait aussi intéressant d'inclure des stimuli anglais pour pouvoir comparer les structures données par les anglophones en langue maternelle et en langue seconde.

Bibliographie

Brière, E. , Campbell, R., & Soemarmo, N. (1968). A Need for the Syllable in Contrastive Analysis. *Journal of Verbal Learning and Verbal Behavior*, **7**, 384-389.

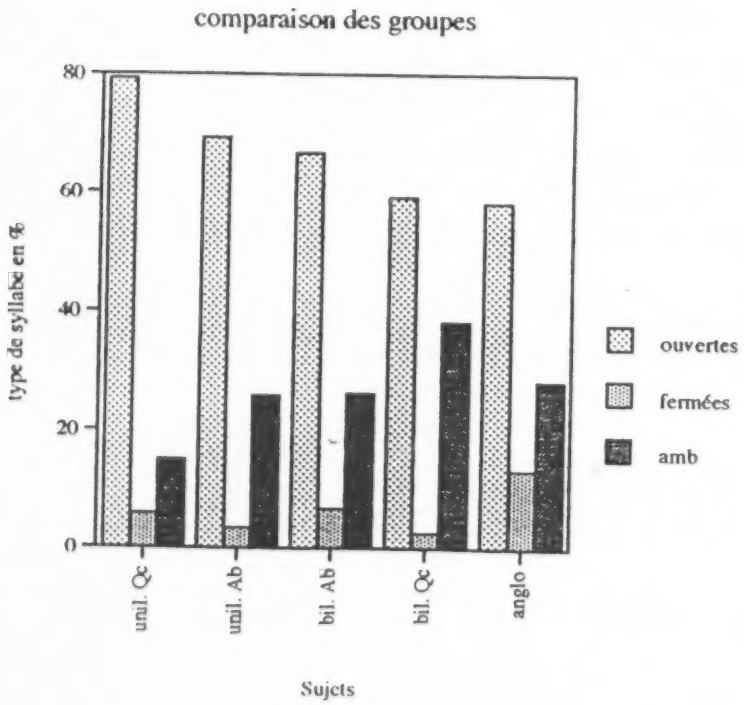
Delattre, P. (1940). Tendances de coupe syllabique en français. *Publications of the Modern Language Association*, **55**(2), 579-595.

Derwing, B. (1992). A 'pause-break' task for eliciting syllable boundary judgments from literate and illiterate speakers: Preliminary results for five diverse languages. *Language and Speech*, **35** (1-2), 219-235.

Mack, M. A. (1989). Consonant and vowel perception and production: early English-French bilinguals and English monolinguals. *Perception and Psychophysics*, **46** (2), 187-200.

Treiman, R. (1983). The structure of spoken syllables: evidence from novel word games. *Cognition*, **15**, 49-74.

Treiman, R. (1988). Distributional constraints and syllable structure in English. *Journal of Phonetics*, **16**, 221-229.


comparaison des groupes
type de syllabe en %
80
60
40
20
0
unil. Qc
unil. Ab
bil. Ab
bil. Qc
anglo
Sujets
ouvertes
fermées
amb

Appendix C: Ethics Committee authorization forms

UNIVERSITY OF ALBERTA
FACULTY OF ARTS, ETHICS REVIEW COMMITTEE
APPLICATION TO CONDUCT RESEARCH INVOLVING HUMAN PARTICIPANTS

PRINCIPAL INVESTIGATOR'S NAME AND PHONE NUMBER
(IF STUDENT, ALSO PROVIDE NAME OF FACULTY SPONSOR AND PHONE NUMBER)
Martin Beaudoin 465-8715
Bernard Rochet (supervisor) 442-1205
Staff research: ___ Graduate student research: ___ Course related research: ___

CO- OR JUNIOR INVESTIGATOR NAME(S) AND PHONE:

NAMES AND PHONE NUMBERS OF ALL PERSONS INVOLVED IN DATA ACQUISITION (EXPERIMENTERS, RESEARCH ASSISTANTS, ETC.):

PROJECT TITLE: Perception of the syllable by bilinguals

WHERE WILL RESEARCH BE DONE?
Faculté Saint-Jean

SUBJECTS/PARTICIPANTS/SOURCES OF DATA:
Volunteers drawn from classes

FACULTY STATEMENT: I have read the responsibilities set out in the document, University Standards for the Protection of Human Research Participants, and agree to discharge those obligations with respect to this project.

12 Nov. '93
DATE

FACULTY SIGNATURE

Martin Beaudoin
PRINTED OR TYPED NAME

BRIEF ESTIMATE OF PROBABILITY OF RISKS OR DISCOMFORT TO PARTICIPANTS:
None, except for the lost of 30 min.

BRIEF DESCRIPTION OF CONSENT FORMS, PROCEDURES TO PROVIDE CONFIDENTIALITY, ANONYMITY, ETC. WHICH MIGHT MINIMIZE DISCOMFORT TO PARTICIPANTS:
Consent form attached. Pseudonyms are transformed into numbers at the end of data collection

BENEFITS OF RESEARCH WHICH MIGHT COMPENSATE FOR ANY DISCOMFORT TO PARTICIPANTS:
the feeling of helping research!

PLEASE PROVIDE ANY ADDITIONAL EXPLANATION/DATA YOU FEEL APPROPRIATE FOR THOSE REVIEWING THIS APPLICATION
attached Text + Consent Form in French

****** ATTACH COPY OF RESEARCH PROPOSAL ******
Send completed application form to the Faculty of Arts, Ethics Review Committee, Department of Sociology

OFFICE USE ONLY

DATE RECEIVED: 15 Nov. 1993

APPROVED BY FACULTY OF ARTS, ETHICS REVIEW COMMITTEE:
James C. Harris, chair, Faculty of Arts, Ethics Review Committee

DATE:
15 Nov. 1993

CONDITIONS OR COMMENTS:
I feel this research presents no problems, and does not require a review by additional members of the committee
C.C.

UNIVERSITY OF ALBERTA
FACULTY OF ARTS, ETHICS REVIEW COMMITTEE
APPLICATION TO CONDUCT RESEARCH INVOLVING HUMAN PARTICIPANTS

PRINCIPAL INVESTIGATOR'S NAME AND PHONE NUMBER
(IF STUDENT, ALSO PROVIDE NAME OF FACULTY SPONSOR AND PHONE NUMBER)
Martin Beaudoin 465-8715
Bernard Rochet (Supervisor) 492-1205
Staff research: ___ Graduate student research: ✓ Course related research: ___

CO- OR JUNIOR INVESTIGATOR NAME(S) AND PHONE:

NAMES AND PHONE NUMBERS OF ALL PERSONS INVOLVED IN DATA ACQUISITION (EXPERIMENTERS, RESEARCH ASSISTANTS, ETC.):

PROJECT TITLE:
The perception of the syllable by ear, by eye, or both ways

WHERE WILL RESEARCH BE DONE?
Faculté Saint-Jean

SUBJECTS/PARTICIPANTS/SOURCES OF DATA:
Volunteers drawn from classes

FACULTY STATEMENT: I have read the responsibilities set out in the document, University Standards for the Protection of Human Research Participants, and agree to discharge those obligations with respect to this project.

12 Nov. '93
DATE

FACULTY SIGNATURE

Martin Beaudoin
PRINTED OR TYPED NAME

BRIEF ESTIMATE OF PROBABILITY OF RISKS OR DISCOMFORT TO PARTICIPANTS:
none except for the last of 40 min.

BRIEF DESCRIPTION OF CONSENT FORMS, PROCEDURES TO PROVIDE CONFIDENTIALITY, ANONYMITY, ETC. WHICH MIGHT MINIMIZE DISCOMFORT TO PARTICIPANTS:
Consent form attached. Pseudonymes are transformed into numbers at the end of data collection

BENEFITS OF RESEARCH WHICH MIGHT COMPENSATE FOR ANY DISCOMFORT TO PARTICIPANTS:
The feeling of helping research

PLEASE PROVIDE ANY ADDITIONAL EXPLANATION/DATA YOU FEEL APPROPRIATE FOR THOSE REVIEWING THIS APPLICATION
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OFFICE USE ONLY

DATE RECEIVED:
15 Nov. 93

APPROVED BY FACULTY OF ARTS, ETHICS REVIEW COMMITTEE:
[illegible]

DATE:
15 Nov. 1993

CONDITIONS OR COMMENTS
[illegible]